The Electrical World.

VOL. XXIV. NEW YORK, NOVEMBER 24, 1894. No. 21.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,
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THE INCANDESCENT FILAMENT.

Some surprise has been expressed that the famous incandescent lamp litigation between the Westinghouse and General Electric interests is still pending, the impression being general that the decision of 1892 was final. The case recently argued before the United States Supreme Court, however, which is an appeal of the McKeesport case, does not involve the incandescent lamp as a whole, the issue being narrowed to the fibrous filament in an arched form. Should the Supreme Court reverse the decision of the lower court, the Sawyer-Man patent, dated May 12, 1885, will be revived as far as concerns the arched fibrous filament, and its life continued to 1902, unless abridged by a foreign patent. It is claimed, however, that this would have no important effect, as the art is not confined to the use of a fibrous material for the incandescent lamp filament.

ELECTRICITY AS A MOTIVE POWER.

It is sometimes said, and truly we believe, that the most conservative engineers in the world are those who have to do with the motive power of steam railways. As a rule they seem to view every engineering innovation with jealous suspicion, and at their professional meetings are apt to make it uncomfortable for the one who is rash enough to propose changing materially the existing order of things. It is, therefore, significant when men of this class speak strongly, even enthusiastically, in favor of electric traction, and this they do in the New York *Herald* of Sunday, which prints the views of the superintendents of motive power of the leading steam railways entering New York and vicinity as to the best motive power for the New York rapid transit roads. The ardent advocate of electricity could not favor more warmly the use of that agent for the purpose referred to. As steam is entirely out of the question, they were able to view the matter in an unbiased light, and we doubt if it occurred to them that their arguments would also apply to the use of electrical power, to some extent at least, on their own roads. One of those interviewed makes the general statement that electricity "is "just the perfect way of applying power," and adds, "Just think of "it, electricity does it all; absolutely all that is required. First of "all, you must have the power, and the electric motor on your en- "gine, fed over a wire from the dynamos, gives it to you; then you "must have light, both for your tunnel and your cars, and you want "a good light, too, and you get it by the same means; and then there "is the question of heating—and an important one—and that you can "get from the electricity. If ventilating fans are needed they can be "run by the same power. Could anything, under the present state "of knowledge, be more perfect? Motive power, light, air and heat "all from the same central power plant,"—which puts the case as strongly as any electrical engineer could wish. Another superintendent states that "the electric motor fills the bill exactly, and nothing "else approaches it;" and still another that "there is really no other "engine that I know of nearly so good as the electric motor operated "from a conducting wire." Not one of those interviewed repeated the remark, so familiar even a short time ago, about the experimental stage of the art, and from the references to the intramural road at the Chicago Fair it is evident that the object lesson it afforded has had a most valuable effect.

THEORY OF THE INCANDESCENT LAMP.

Prof. H. S. Weber's paper on the theory of the incandescent lamp, an abstract of which was printed in our last issue, is by far the most important contribution yet made to the subject. The best work heretofore done in this line has been by Americans, but it has been rather fragmentary, while the paper of Prof. Weber is exhaustive in its scope, and embodies the first attempt to treat the

subject from other than an empirical standpoint. As stated in the paper, the starting point of the work was the establishment of an expression by means of which the intensity of radiation of a given wave-length emitted by a filament at a given temperature might be expressed in terms of the wave-length and temperature, and of the size and nature of the radiating surface, the radiation being expressed in terms of the corresponding energy. By means of this equation the temperature of the filament can also be calculated, and we learn through this the surprising fact that the normal temperature of all kinds of incandescent filaments is very nearly the same, and included between an interval of 1292° and 1307° centigrade, and that the filament of a 16-cp lamp only changes 180° C. in temperature from two to thirty candle-power. The law of change of temperature for practical variations therefore becomes very simple, every increase of the energy of the current amounting to one-half per cent. raising the temperature of the filament 1° C. Prof. Weber found from his exhaustive experiments that the empirical relation, according to which the intensity of light is proportional to the cube of the energy transformed, well founded, and combining this relation with those he had himself established, it is shown that a rise of one degree in temperature within working limits produces a diminution of one per cent. of energy necessary for the production of a unit of light. A useful practical result of Prof. Weber's work is that we are now enabled to calculate very exactly the dimensions of a filament for a given purpose. By far the most interesting result, however, is the application of the general expression established to the calculation of the optical efficiency of the incandescent filament. We have recently referred to the uncertainty of the data on this point, and Prof. Weber finds that the experimental determinations of Blattner and Merritt are in error owing to unjustifiable assumptions; applying corrections to their results as far as concerns the absorption of dark rays, he reduces the value of the former from 5 per cent. to percentages varying from 3 to 4.9, depending upon the temperature of the filament. From his own expression, however, he calculates an optical efficiency varying from .55 to 1.17 per cent. according to the temperature of the filament, and concludes that for normal temperatures of incandescent filaments the optical efficiency is in the neighborhood of 1 per cent. While this does not agree with the surprising value of Ebert, which we have lately discussed, yet, as it is based upon theoretical grounds that have been checked throughout by experiment, it seems to merit more confidence than any other value yet offered.

SYMBOLS AND ABBREVIATIONS.

We print elsewhere an editorial of our esteemed London contemporary, the *Electrical Review*, which takes exception to our recent remarks on Prof. Jamieson's criticism of the symbols, notation and abbreviations which the Committee on Notation of the Chicago International Electrical Congress recommended "for international employment for practical use." In characterizing Prof. Jamieson as "an unfriendly critic with a rival system" we meant no personal disrespect, for none more thoroughly appreciates than ourselves his sterling qualities, both professional and personal. Certainly a criticism cannot be considered friendly that repudiates almost every essential point of the International Congress system and which, if it were to have the effect intended, would deprive us of almost the only possible hope of ever arriving at an international agreement on the subject. For if the attempt inaugurated at Chicago fails, a succeeding one will not stand any better chance of success, as the details must be largely matters of opinion which cannot be satisfactory to all, and the first failure will discredit further experiments. The important matter is uniformity in symbols, notation and abbreviations and to this the question of details is largely subsidiary. This matter has been a pressing one and the action at Chicago in recommending the system of M. Hospitalier gave it an advantage which would counterbalance many demerits in detail, did it possess them, which we do not think it does. Prof. Jamieson was at Chicago, we believe, and must have been aware that the system of Prof. Hospitalier was to be brought before the Chamber of Delegates. He should then have entered his objections, which he certainly could have done through one of the delegates. It is certainly a late day to do so now, particularly in view of the fact that in this country the system has entered into general use, and before another Congress could be held, will probably have become permanently fixed notwithstanding the most strenuous efforts that might be made to supercede it by one of less authority. If, therefore, the changes recommended by Prof. Jamieson were ever so desirable, we would, though with regret, still consider them entirely impracticable as tending to defeat an object which is higher than the mere perfection of details. While, as our contemporary states, Prof. Jamieson is entirely within his rights in criticizing the system in question, we doubt the expediency of his so doing at the present time, unless he prefers no system rather than the Congress one, and by destroying it, render still smaller the probability of future uniformity. As to the International Electrical Congress not having formally adopted the system, the reason is simply because it was not within its province to do so. Its formal action was confined to the adoption of measures for subsequent governmental action, and it could scarcely have called upon the various governments of the world to legalize a system of notation. The recognition it did give was, therefore, as complete as it had the power to give, and even more than might have reasonably been expected. The criticism by implication of the Committee of Notation we believe to be uncalled for; as it was composed of Ferraris, Ayrton, Carhart, Hospitalier, Palaz, A. Siemens and Dr. Budde, it appears to have been sufficiently expert and international. As to the fullest scope for discussion and the expression of diverse opinion, there was ample opportunity for this before the meeting of the Congress. The system had been before the world for some years; it had been formally brought in 1891 before the Frankfort Congress and was by it referred to a Committee for report to the next Congress, and it was published by the Committee on the Provisional Programme for the Chicago Congress in order to invite discussion. It is rather unreasonable, in the light of this, to imply that there was not ample opportunity to publicly criticize the measure. Finally, the system of Prof. Jamieson was embodied in a paper read before the Congress, and even if the members of the Committee on Notation—two of whom are compatriots of Prof. Jamieson—were not aware of its contents, the majority, we feel sure in saying, were acquainted with the system through Prof. Jamieson's "Pocket Book." As they entirely disregarded it, a fair presumption is that they did so for good reasons, and therefore one would be justified in considering Prof. Jamieson's attack on the system which did receive recognition as arising from the disappointment of a defeated rival.

Storage Battery Litigation.

A decision was rendered on November 5, in the United States Court of Appeals for the Second Circuit, in the case of the Accumulator Company vs. The Edison Electric Illuminating Company, and The Electric Storage Battery Company, by Judge Wallace, affirming the decision of Judge Lacombe, an abstract of which appears in The Electrical World of October 20, enjoining the Edison Electric Illuminating Company of New York from using the chloride battery, on the ground that it is an infringement of the Swan-reissue patent.

The Chloride Storage Battery.

The Electric Storage Battery Company sends us the following communication in regard to the decision of the U. S. Court of Appeals for the Second District, in the case of Accumulator Company vs. Edison Electric Illuminating Company: "The day following the opinion of the Court upon the application of the counsel for the Edison Company, the Court gave leave to file an application for rehearing to be submitted in printed form, and accompanied with a printed argument in support thereof, and denied the motion of the counsel for the Accumulator Company for the mandate, holding that in abeyance until the decision was given upon the petition for a rehearing. The decision in no way affects the business of the Electric Storage Battery Company, but applies solely to the New York Edison contract, and even if affirmed will only delay that work until May next when the Swan patent expires."

Hermann von Helmholtz.

BY M. I. PUPIN.

It was in the autumn of 1885 when I began my studies under the late Prof. von Helmholtz. Kirchhoff was then still living. He lectured during that semester on the Mathematical Theory of Electricity. Helmholtz was director of the Physical Institute and lectured on Experimental Physics. As I think of those times now a comparison between the methods of these two great physicists suggests itself to my mind. This comparison seems to me to show Helmholtz in his true light as a teacher.

Kirchhoff's lectures were finished masterpieces of mathematical analysis and simple logic. There was nothing to add and nothing to subtract. No outside reading was necessary, in order to follow the rigid line of argument from beginning to end. But if one wished to supplement his lecture-room notes with outside reading, there was the literature of the German school of mathematical physicists, the school of Gauss, Neuman, Dirichlet, Riemann and others. Kirchhoff was a faithful apostle of this school. In spite of several interruptions due to Kirchhoff's illness to which he succumbed the same year, his course on electricity was completed by the end of the semester, so well was the work divided and so completely were the lectures under the control of the lecturer.

Helmholtz, on the other hand, rarely, if ever, seemed to have covered the whole ground of the subject which he proposed to discuss during the semester. But it should be remembered that the student measures the extent of that ground by the requirements for the doctor's degree examination. To supplement their lecture-room notes by outside reading was difficult to most beginners, for Helmholtz put things so differently from everybody else.

Kirchhoff's classes kept constant in number during the whole term. Those of Helmholtz, especially when he began to lecture on Mathematical Physics, grew smaller and smaller as the end of the semester approached. But then, Kirchhoff taught and Helmholtz inspired. Kirchhoff was an apostle, Helmholtz was a prophet. The masses wish to be instructed; it is only a small number, even in a German University as large as that of Berlin, who are open to inspiration. It was this small number who remained faithful to Helmholtz from the beginning of the semester to the end. In Kirchhoff's lectures it was the mathematical technique which seemed to play the most important part and to fascinate the student. Physical quantities were represented by functional symbols whose chief beauty seemed to consist in their fitting so well into certain mathematical operations. The young student was very apt to form an idea from these lectures that if it were not for mathematical analysis our knowledge of the physical phenomena would come to a standstill. More than half the number of those who attended Kirchhoff's lectures were pure mathematicians.

HERMANN VON HELMHOLTZ.
(From the Painting by Knaus)

In Helmholtz's lectures it was the physical conception of the subject under discussion which stood out prominently and challenged the attention of his hearers. The mathematical treatment of it looked like a matter of convenience, not of absolute necessity, and many a hearer of Helmholtz grasped for the first time the full meaning of mathematical analysis when he saw it perform the office of interpreter of Helmholtz's physical reasoning. To such men it would, of course, appear that if it were not for the advance of our knowledge of physical phenomena the progress of pure mathematics would come to a standstill. Those who were fortunate enough to get a strong grasp of Helmholtz's physical conceptions, did not in the least mind that on many an occasion there was a hitch in the purely mathematical parts of his lectures, nor the fact that his course did not work out completely all the details of the subject under discussion which the regulations or the doctor's degree examination required. In this sense many of Helmholtz's courses of lectures on Mathematical and Experimental Physics might be considered as unfinished, but they should then be compared to the unfinished pieces of sculpture of Michel Angelo. We admire in them the grand conception of the great sculptor and in this admiration we do not notice that a large part is only a crude and shapeless rock. The connoisseur grasps the artist's meaning and his imagination supplies the unfinished parts of the artist's work. But not everybody who visits the Medicean Chapel in Florence is filled with admiration of Michel Angelo's genius.

Among the many students who used to assemble in Helmholtz's lecture-room at the beginning of every term, there were usually but few who could follow the master to those arduous heights which he bade them ascend and obtain the wide view of the subject on which he discoursed. Hence the opinion which one hears from time to time that Helmholtz was a poor lecturer. Those who understood him had an unbounded admiration for his lectures and a feeling of deep affection and gratitude for the man to whose inspiring words they owed so much of their intellectual growth. The affection of his pupils for him he reciprocated in a quiet and dignified way. His pupils will understand fully the depth of feeling which prompted the following sentence in Helmholtz's preface to Hertz's "Principles of Mechanics," lately published. Speaking of the sorrow which the scientific world felt over the death of Hertz, he says: "I myself have felt this sorrow deeply, for among all the pupils which I have had I always felt that I could consider Hertz as the one who had gained the deepest penetration into the sphere of my own scientific ideas, and I dared to cherish the strongest of hopes that he would develop and extend them."

In many respects the method of Helmholtz's teaching was like that of Socrates. He devoted the greatest possible attention to the formation of correct scientific ideas in the minds of his pupils. A clear and complete exposition of the fundamental concepts and principles received his closest attention. He seemed to consider this as very much more important than the application of these principles to the solution of a great variety of physical problems. Just as in his writings, so in the lecture-room, he never hesitated to cross what some would consider the boundary line which separates Physics from Metaphysics, in order to show clearly the very roots of the elementary concepts which underlie the Science of Physics. I remember well his discourse on the meaning of *force*, a discourse with which he usually introduced his course of lectures on Experimental Physics. I saw it again afterwards in his public lecture on "The Aim and Progress of Physical Science," delivered in 1869. It is this: "To find the law by which they are regulated is to understand phenomena. For law is nothing more than the general conception in which a series of similarly recurring natural processes may be embraced. Just as we include in the conception 'mammal' all that is common to the man, the ape, the dog, the lion, the hare, the horse, the whale, etc., so we comprehend in the law of refraction that which we observe to recur regularly when a ray of light of any color passes in any direction through the common boundary of any too transparent media. A law of nature, however, is not a mere logical conception that we have adopted as a kind of memoria technica, to enable us to remember facts more readily. We of the present day have already sufficient insight to know that the laws of nature are not things which we can evolve by any speculative method. On the contrary, we have to discover them in facts; we have to test them by repeated observation or experiment, in constantly new cases, under ever-varying circumstances; in proportion only as they hold good under a constantly increasing number of cases and with greater delicacy in the means of observation, does our confidence in their trustworthiness rise.

"Thus the laws of nature occupy the position of a power with which we are not familiar, not to be arbitrarily selected and determined in our minds, as one might devise various systems of classifying animals and plants, so long as the subject is only one of classification. Before we can say that our knowledge of any one law of nature is complete we must see that it holds good without exception, and make this the test of its correctness. If we can be assured that the conditions under which the law operates have presented themselves, the result must ensue without arbitrariness, without choice, without our coöperation, and from the very necessity which regulates the things of the external world as well as our perception. *The law then takes the form of an objective power, and for that reason we call it force.* For instance, we regard the law of refraction objectively as a refractive force in transparent substances, the law of chemical affinity as the elective force exhibited by different bodies towards one another. In the same way, we speak of electrical force of contact of metals, of a force of adhesion, capillary force, and so on. Under these names are stated objectively laws which for the most part comprise small series of natural processes, the conditions of which are somewhat involved. . . .

"The force arising from the presence of such and such bodies is equivalent to the acceleration of the mass on which it operates multiplied by this mass. The actual meaning of such an equation is that it expresses the following law: If such and such masses are present and no other, such and such acceleration of their individual points occur. Its actual signification may be compared with the facts and tested by them. The abstract conception of force we thus introduce implies moreover, that we did not discover this law at random, that it is an essential law of phenomena. Our desire to comprehend natural phenomena, in other words, to ascertain their laws, thus takes another form of expression,—that is, we have to seek out the forces which are the causes of phenomena."

Who can still entertain any doubt as to the meaning of the physical concept *force* after hearing such a discourse? I confess that this discourse revolutionized my ideas on the subject of Mechanics, and of Physics in general. It seemed to lift a cloud from my mind, and I felt as if I saw light for the first time in my life. I have not met a pupil of Helmholtz yet who did not share my feelings. This was only one of the many discourses which could not fail to produce the most profound impression upon the minds of his more advanced pupils and to mark distinct epochs in the development of their scientific ideas.

In the laboratory he was the same as in the lecture room; he seldom allowed himself to enter into a discussion of the minor details of a man's work. He would always listen patiently to his pupil's account of the progress in his investigation; points of small importance left him indifferent; a mention of real a difficulty would always strike a sympathetic chord in his heart. His expression would then suddenly change, and you saw before you the magnificent face of Helmholtz, the philosopher, wrapped in serious attention as if searching carefully through the endless labyrinth of his mighty brain for a solution of your difficulty. Before he concluded his visit to your room the deep furrows on his Olympian brow would in all probability smoothen out gradually and then it would seem as if the shadow of his contracted eyebrows had lifted from his luminious eyes. Their benevolent light would then bring the cheerful news to you that Helmholtz, your friend, had found a solution of your difficulty and was ready to help you. You saw before you Helmholtz, the discoverer, rejoicing in a little discovery which is going to help you, but which gives the discoverer just as much pleasure as if it were going to add new glory to his already brilliant fame. In a few and simple words he would then give you his fatherly advice, bow politely, and proceed on his way to your next door neighbor where Gordian knots in form of experimental difficulties of perhaps entirely different nature waited for his intellectual sword. On such occasions you would stand as if spell bound for many a minute after his departure. His pleasing gentle voice would keep on ringing in your ear, the new view of your own subject of investigation which he had just suggested to you would gradually develop broader and sharper in definition, and the image of his magnificent face would seem to have produced an impression on your memory that would remain there forever with undiminished intensity. I often wished that I had the painter's skill so as to be able to fix on canvas the magnificent play of expression on his intellectual face whenever in the lecture-room or in the laboratory Helmholtz attacked and completely vanquished a difficult problem. It is beyond description. His photographs give no trace of it. There is one picture, only, which reminds one of it very vividly. It is the portrait of Helmholtz by Knaus in the National Gallery in Berlin. It represents Helmholtz as he used to look when he revolved in his mind a bright idea which suggested the solution of a difficult problem. The engraving accompanying this note is from a photograph of this portrait.

What he was to his pupils that indeed he also was to all the scientific world; a great intellectual leader, leading on steadily to greater and greater intellectual victories. So broad and so profound, so epoch-making and so penetrating were his intellectual powers that if real prophets in science ever existed he was certainly one of the greatest among them.

Professor von Helmholtz.

BY HENRY S. CARHART.

It needed no deep intuition at the opening of the Chicago Electrical Congress to discover the intense satisfaction with which the hundreds of persons interested in the science of electricity listened to the simple, kindly words of Professor von Helmholtz on assuming the honorary presidency. On the platform about him sat the official delegates of ten governments; in the audience were not only representative electricians from every part of the United States, but many from foreign lands. These all with a sudden impulse rose to their feet in hearty welcome and with spontaneous homage as this man of world-wide fame stepped forward to respond to the words of welcome addressed to him.

America saluted Germany, and American enthusiasm was reflected from the glowing faces of a small group of his countrymen and colleagues in attendance. It should be gratifying to the Americans who were there to know that the honor was appreciated. When Professor Rowland and myself, who were delegated to confer with him respecting his acceptance of the honorary presidency, called to see him, he received us with much cordiality, and showed unreservedly the fullest appreciation of the honor which it was desired he should receive.

At the dinner given in honor of the foreign official delegates every man felt himself personally included when this grand representative of sturdy German science addressed the company under the pleasing fiction of a father speaking to his children. No one present can forget the sympathetic tone of his remarks, and none could fail to note the indications that, under all American crudities, he still detected and recognized the worth that other less broad and penetrating minds might not discover.

Professor von Helmholtz could hardly have felt himself a stranger among us, for scores of Americans have been his pupils; and no one who has studied under him could fail to consider him a friend for, though never demonstrative, he was nevertheless always kindly and considerate. His daily round of the laboratory rooms was always an event to look forward to, for he was never in too much haste to be willing to give patient attention to any problems taxing the student's ability. The service which he thus rendered to students in his laboratory must be looked upon as a generous giving of himself, rather than as a necessity of the situation; for able assistants were in attendance to respond to all reasonable demands. At the time of my own experience there Dr. Hagen, now in the Reichsanstalt, was first assistant, and the brilliant, but now lamented, Professor Hertz was second assistant.

While his personal attention doubtless proved very stimulating to many American students of physics, yet it may fairly be questioned whether it was not rendered at too great a cost. When one considers the invaluable contributions to science which he made by investigations carried on in the remnants of time not absorbed by courses of lectures, and the exacting care of a large laboratory, one must regret that the investigator did not engross a larger portion of his time and the teacher less.

There was something almost pathetic in the account which he gave at the Edinburgh meeting of the British Association in 1892 of the difficulties encountered by an investigator, who must at the same time give attention to the affairs of a large physical laboratory. The picture which he drew was true to life, and was no less typical of America than of Germany. The question under discussion was the necessity of establishing national laboratories for physical and chemical research, like the Reichsanstalt in Berlin. Every man of similar experiences felt the truthfulness of his description of the manner in which one's time is consumed, and the injury done to the apparatus which one needs and which must also be used by students, till finally, when everything is in readiness for work, only perhaps a quarter of an hour remains for the "hauptsache." Under such unfavorable conditions as these Helmholtz carried through several series of researches which have let in the light on important physiological and physical problems for all time. His work was nearly finished before the liberality of Werner von Siemens and

the coöperation of the German government enabled him to devote his entire time to the direction of research.

Von Helmholtz has sometimes been called a poor lecturer, or at best an indifferent one. I cannot agree with that estimate of his work in the lecture room. He certainly was not a brilliant lecturer, and he sometimes made errors in his equations. But these errors were not those arising from lack of information or grasp of the principles involved. They were rather such slips as one commonly makes in manipulating mathematical symbols, when one has not taken the time to go over a lecture and to become familiar with its details. His methods were so original that the manner in which a conclusion was reached one year would very likely give place to another, when the same course of lectures came to be repeated. And it was often evident that he disregarded his notes before him and pursued a different plan. In so far as his lectures were faulty or contained errors in the details, the explanation probably lay in the fact that Helmholtz, the teacher, was sacrificing time to Helmholtz, the investigator.

I shall always carry with me a mental photograph of my last sight of this great man. It was on the Saturday afternoon following the closing of the Electrical Congress, and shortly after the delightful luncheon which he gave at the German Village in the Midway Plaisance to the members of the Chamber of Delegates and a few others. He was approaching the Administration Building from the west in a roller chair and unattended by friends. His large full eyes, alas! less brilliant than ten years earlier, were fixed aloft on that magnificent gilded dome which pierced the sky and formed the central point of attraction from every quarter. There was in his admiring gaze a touch of aspiration and reverence befitting one who was approaching so near to life's border land. The larger part of his work was on the border land of science in advance of most of his contemporaries. Almost the last thing which he said to me on leaving his laboratory was that the most promising field of physical research was on the dividing line between physics and chemistry. But he has crossed the greater border line, and his path, like the path of the just, "is as the shining light, that shineth more and more unto the perfect day."

The Bate Refrigerator Case.

The argument in the Bate Refrigerator case, which we are herewith enabled to present to our readers, so far as it has proceeded, through the kindness of C. L. Sturtevant, Esq., a prominent member of the patent bar of Washington, was begun before the United States Supreme Court the afternoon of Nov. 15, by Mr. Mitchell, and was continued the next day by that gentleman, Mr. Peckham, Mr. Wetmore and J. C Carter, who had not finished Friday afternoon, when the case was adjourned to Monday.

As our readers probably know, the question involved is as to the limitation of United States patents by a prior foreign patent. The contention in behalf of Bate is that Section 4887 of the Revised Statutes, causes a curtailment of the life of the American patent, when the foreign patent precedes the American *application*, while the defendant insists that it applies whenever the foreign grant precedes the American *issue*. The suit was originally brought by the Bate Company against Schwarzchild & Sulzberger, in the Southern District of New York, and the bill was dismissed upon defendant's plea that the patent had been issued in England upon the same invention, between the dates of the application for, and the issue of, the patent in the United States, and that, therefore, the latter patent had expired with the English patent, prior to bringing the suit. The case went to the Court of Appeals, and that Court certified the case to the Supreme Court of the United States, upon this question in effect: "When did, or when does, the patent granted Bate expire?"

Almost all the great companies, whose patents will be affected by this decision, were represented at the hearing, by counsel, among these being J. J. Storrow, for the Bell Company, and L. E. Curtis and Paul D. Cravath for the Electric Lighting Companies. W. H. Kenyon, it is understood, has filed a brief in support of the position taken by the defendants, on behalf of the Harrison International Telephone Company. B. F. Lee, for the Chemical Rubber Company, has filed a brief in support of the contention by the Bate Company, and ex-Solicitor-General Chas. H. Aldrich was given leave to file a brief for Milo G. Kellogg, of Chicago.

During the course of Mitchell's argument, Judge Brewer said, "I note that the oldest decision cited by you, as holding what you term the 'hostile view,' was rendered in 1882. That was twelve years ago. If the construction heretofore given by the courts was wrong, has there not been ample time to seek remedy by legislation by Congress?" To sum the matter up briefly, Mitchell and his associate contend that Section 8 of the act of 1836, and Section 6 of the act of 1839, having referred only to the *application* in this country, that R. S., 4887, being a substitute therefore, is by the marginal notes, or reference to this previous clause, to be construed in the light of the latter, and hence that the statute refers only to inventions patented abroad prior to the *filing of the application* here.

Mitchell finished his argument shortly after court convened Friday morning, and was followed by Wheeler H. Peckham, who preceded Edmund Wetmore. Peckham opened his argument by commenting on the recent patent to Berliner, arguing that he had allowed his case to stand in the Patent Office for many years, and had it issued just before expiration of Bell patent, and remarked that if the defendant's contention is sustained the monopoly of the Bell Company is prolonged nearly seventeen years, since Berliner had patented in many foreign countries *subsequence to his filing*, but *prior to the issue* here. He further remarked that the Berliner invention had been used on every telephone from the outset.

Wetmore, who followed Peckham for the defendant, summed up as follows: The Constitution of the United States provides for protecting inventions in order to promote useful arts in the United States. The country in which an invention is first patented is the one in which it will be first applied, because in such country it is protected and capital can therefore be interested. The country in which the invention is first applied is the one which will be first benefited. For this reason it is advantageous to enact such laws as will encourage the first patenting in this country; secondly, if a patent is obtained here for seventeen years, and previously in a foreign country, for say ten years, at the end of the ten years the foreign country's public will be the owners of the invention, and the article may be bought there for a small price, while the people of the United States will still be subject to the monopoly, and will, therefore, be placed at a disadvantage with reference to the foreigner. Judge Harlan here asked: "How about the case in which one obtains a patent here and then obtains one for a shorter foreign term?" Mr. Wetmore replied that the law had gone as far as it dared to correct the evil, for it said that a United States patent should be limited by the term of a foreign patent subsequently granted, it would practically destroy our patent system, and make a United States patent worthless, since the United States patentee could sell his patent granted here to-day, for $50,000,000, and could to-morrow obtain an Italian patent for one year, and thus make the United States patent all but worthless. He contended that the usual explanation of the construction of the section of the statute would be that the foreign patent must be granted prior to the grant of the United States patent; that such was the intention of the Congress which framed the act; that this had been ratified by all subsequent Congresses, for they had not changed the law, although the courts had uniformly given it its present construction. In response to a question from Judge Shiras, Mr. Wetmore admitted, of course, that he referred only to the Circuit Court decisions, and that they could have weight only as such before the Supreme Court. He said that the construction they asked for was the one which most strongly benefited the public of the United States, and was the only one which it is presumed was intended by the Congress which enacted the law. Finally, that while the Bate Company has a large capital at stake, it is nothing compared with the immense amount of capital which has been invested because of the present construction of the statute, and that this capital would be rendered almost worthless if the Supreme Court changed the construction of the law.

Mr. Carter followed Wetmore, but did not finish on Friday evening. He opened by saying that a patent is a contract, and that a consideration should be had of the law as it existed at the time the contract was made. That it had been repeatedly held that the United States must rigidly perform its side of the contract. That the contract is to the effect that if the inventor will describe fully his invention and file this with the proper officer, the United States will grant him a patent. That applicant accepts the contract, and the same is consummated as soon as the *application is filed*.

Introduction of Telegraphy.

According to the British Board of Trade statistics, the first telegraph line which was ever opened was in Germany in the year 1833; the next that in Great Britain in 1837, and then in the United States in 1844; Spain had no lines until 1885.

Odd but Consistent English Names.

A town in Scotland in which the electric light is about to be introduced has the curious name of "Motherswell" and there is said to be a small promontory near it called "Bubhe Babyshill."

The Society of Naval Architects and Marine Engineers.

At the successful meeting in New York last week of the Society of Naval Architects and Marine Engineers, two papers were presented dealing with electrical subjects, one by Lieut. S. Dana Greene, of the General Electrical Company on "Electricity on Shipboard" and the other by Naval Constructor W. J. Baxter, U. S. Navy, in which is incidentally described an electrical method of determining the co-efficient of friction of launching ways.

Lieut. Greene advises the naval architect in designing and installing a marine electric plant, whether it is for a man-of-war, merchantman, or yacht, to see that the material is ordered from manufacturers who have made a specialty of marine apparatus and to have it installed by practical marine electricians, who beside knowing something about electricity, know what a ship is and what the conditions are at sea. The plant should be put in charge of good practical, dynamo-tenders, by which is meant men who are familiar with both steam and electrical machinery and their fittings. The best practice in electric installations, it is added, is to be found in the various navies of the world, where specifications are always more rigid and work is better done (at greater expense of course) and more closely inspected. Referring to the naval specification requiring that the maximum rise of temperature shall be only 50° Fahr., he states that this low limit makes the dynamos expensive, and a limit of 60° or 70 Fahr, can be allowed with reasonable safety in the merchant marine under ordinary conditions. Lieut. Greene opposes the use of lead covered wire aboard ship and recommends the employment of iron tubing lined with a non-conducting material for circuits passing through the engine and fore-rooms, and bunkers and along exposed decks.

The employment of electric motors is advocated for ammunition hoists, handling the turrets of battle ships and the heavy turret guns, and for torpedo discharge apparatus; also for ventilating blowers, portable drills and pumps, deck hoists located some distance from the boilers, for driving ice machinery, opening and closing water-tight doors and operating machinery in engineers' workshop and the valves of the steam steering engine, and eventually displacing the steam steering engine itself.

All of the various electrical appliances now in use in the navy are explained at greater or less length, and in conclusion attention is directed to the possible use of steam turbines direct coupled to dynamos. It is stated that their great compactness and simplicity of construction make them particularly suitable for marine plants, while their comparative high speed permits of the use of a very cheap dynamo; for in dynamo construction the cost of manufacture varies almost inversely as the speed. Several shore plants using the direct connected steam turbine have been installed in England, and the reports thus far are very favorable. If they prove reliable in service, some sacrifice of steam efficiency can well be afforded with their introduction aboard ship, on account of their many compensating advantages.

Naval Constructor W. J. Baxter, U. S. Navy, in a paper entitled "Notes on Launching" described an electrical method of determining launching velocities and co-efficients of friction, which are of great value in determining the resistances of ships after launching and the power required to stop them after leaving the ways. The apparatus used was the same as that employed on the contract trial of the U. S. S. "Bancroft" to determine very accurately the speed of the vessel. The instrument is a modification of the Morse register, and when employed on speed trials, five pens, electrically controlled and having a piano contact action are in operation. When the corresponding circuit is completed, a pen makes a dash on a paper tape which is moved by a clock train with extreme uniformity. The central or time pen is connected with a chronometer and marks each second; the revolution pen on each side marks each revolution of the port and starboard shafts; while the outer or range pens mark simultaneously the instants of beginning and ending the measured mile run, permitting a datum line to be drawn across the tape from which are measured the fractional parts of time and revolution.

The register was adapted for the launch of the "Raleigh" by fitting a make-circuit attachment, connecting with a revolution pen, to the axle of a pulley, around which was coiled a steel piano wire with one end connected ashore; the range pen was connected to a portable button in the hands of an observer; while the time pen was connected to a break-circuit chronometer and relay. The register and two sets of drums and pulleys were placed underneath the launching platform at the bow. When the men began sawing off the sole piece, the observer signalled to an assistant, who threw on the circuit and started the register; the time pen began marking at once, and, as the ship moved, the revolution pens began marking, all three acting automatically until the finish. The observer, with the range pens, noted the time of starting, letting go the anchor, pivoting, stoppers breaking, and hawsers tautened. etc. Owing to the admirable performance of the register, very accurate results were derived, both on the launch of the "Texas" and the "Raleigh" and many data of value deduced.

Symbols and Abbreviations.

We are quite at a loss to understand, says the London *Electrical Review*, why The Electrical World should, in an article with the above heading, published in its issue of October 13, characterize Professor Jamieson as "an unfriendly critic with a rival system." We are quite certain that his strictures on the recommendations of the Committee on Notation, which we published alongside these recommendations in our issue of September 21, were conceived in no unfriendly spirit, and that nothing unfriendly was meant by him, who has the furtherance of the object sought after as much at heart as any man we know. Regarding his having a "rival system," that surely is a very wrong and paltry way of looking at the matter. Our correspondent is a man who holds strong and decided opinions upon certain subjects, and naturally claims and exercises the right to express and to advocate his views, so long as it is open to him to do so. That he is still quite within his rights in criticising the proposed scheme is apparent from the following quotation from our American contemporary, which appeared in the issue of September 2, 1893: "The table of symbols and abbreviations recommended by the sub-committee of the delegates and received by the chamber of delegates, *without, however, being adopted by them*, is, with few changes, like the original proposition of M. Hospitalier, and published in the Electrical World of June 10, 1893." This shows that the whole thing is merely tentative; else, why was it not adopted by the Congress and recommended by them for adoption as an international table? It is just possible, however, that it is because our correspondent disagrees more with the personal recommendations of the Electrical World, and of M. Hospitalier, than with the international ones, that our contemporary unkindly describes him as "unfriendly." If the recommendations were really international in the proper sense of the term, there would be much more likelihood of their immediate adoption. In any such system there must be a great deal of give and take—the sinking of mere personal inclinations before the will or usages of the majority. But, in order to merit such give and take, the body which draws up such recommendations must fulfil three conditions: (1) It must be composed of experts; (2) it must be truly international; and (3), it ought to give the fullest scope for discussion and the expression of diverse opinions. With regard to the first condition, there was only one man, or at most two, in the whole committee who had really studied the subject. With regard to the second, was it really international? Is it not the case that this country was represented at the discussion by only one man, and he of foreign birth? And with regard to the third, were any steps whatever taken to throw the meetings open, or to obtain the views of those who were best entitled to express them? As our contemporary has very justly remarked, "Only delegates and a few invited guests were admitted to the sessions, which, in our opinion, was a most unfortunate feature, as the countries will probably never know how efficient or inefficient their delegates were." In fact, the whole thing seems to have been got up without due preparation and certainly without adequate realization of the importance of the issues involved.

Electrical Muscle Making.

In our issue of August 11th, we published a short filler under this heading, based on an abstract in the Digest of the preceding issue under the heading "Electricity in Therapeutics." As these brief abstracts have since been reprinted in other papers, and judging from the number of inquiries we have received, have been of special interest to a large number of readers, and as the matter from which this was taken was published in an English journal that may not be accessible to many, we reprint below the whole editorial on this subject which appeared under the heading "Electricity in Therapeutics" in the London Electrical Review of July 13th. Those specially interested will do well to read the original French article.

"Electricity has been used for many years in a rule of thumb fashion for stimulating the nutrition of the muscular system. It is quite time the matter were treated more scientifically. In the application of electricity to human diseases, there has always been too much of an appearance of quackery; and the "G. P." usually resorts to it only as a last resource, without having any views or

knowledge as to its precise action. Researches like those recently made by Debedat (*vide Arch.d'Electricité Médicale*, March, 1894) are calculated to change all this, and make electricity as certain a remedy as are the mercury compounds in cases of syphilis. The preliminary experiments were wisely made upon animals, rabbits being selected as the victims to science. The various kinds of electrical stimulation used in medical treatment were all tried, and the results of the investigation are now accessible. The groups of "ham-string" muscles were chiefly experimented with; those of the left side being stimulated daily for twenty days, four minutes per diem, and those of the right side being left for purposes of comparison. At the end of the period the animals were killed and the muscles of the two sides removed and weighed. Portions were also hardened and examined microscopically. The modes of stimulation were as follows:—(1) Induction-coil current; groups of shocks lasting each for one second and followed by one second interval of rest. (2) Galvanic battery current of 2 milliamperes with the same periods of stimulation and repose. (3) Static sparks of 2 to 3 milliamperes repeated every two seconds. (4) Tetanisation of muscles for four minutes by means of an induction coil without intervals of repose. (5) Steady galvanic battery current for four minutes without intervals of repose. The results showed a gain of 40 per cent. of weight on the stimulated side of the animal with (1) the rhythmic induction shocks, and of 18 per cent. with (2) the rhythmic battery current. The effect of (3), the static sparks, was *nil*. The prolonged tetanisation (4) caused a loss of weight. The prolonged steady battery current (5) caused a slight increase of weight. [Adhesions had been formed between the skin and the muscles at the points of application of the electrodes in this last series of experiments.] It is clear from the results of these experiments that the gain in weight of the muscles was due to a true growth of muscle; and that the loss of weight noticeable in certain of the experiments was accompanied by histological evidence of damage to the muscular fibres. Hence Debedat concludes that the most advantageous mode of promoting the healthy growth of muscle by means of electricity is to use an induction coil, and to arrange the periods of contraction and repose so as to approximate to the conditions of a muscle during the performance of rhythmic gymnastic movements, namely, about 30 periods of contraction and 30 periods of rest per minute. Proonged tetanisation is distinctly hurtful, and this shows that the methods most commonly made use of by ill-informed practitioners and worse informed quacks are entirely wrong."

Electrical Power Transmission—III.

BY LOUIS BELL, Ph D.

Coucerning Electrical Energy.

16. Now return to Fig. 5 and consider the effect if the wireA is carrying a steady flow of electrical energy. It will set up electro-magnetic stresses about it as already described. If the current be downward into the paper in A these stresses will be opposed to the stresses in the field. Inasmuch as we have seen that in setting up such a current work had to be done in forcing the wire into the field it follows that given such a current, there must be between its field and that of the coil a repulsive force which had to be overcome by doing the work aforesaid. In other words, there must have been a tendency

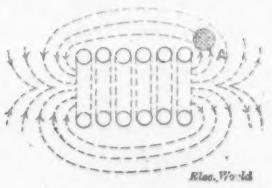
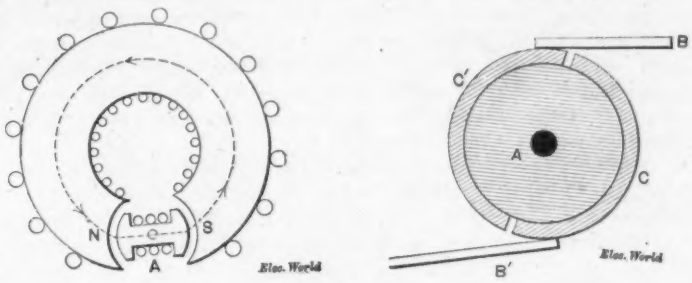


FIG. 5.

to throw A out of the field of the coil. Just as work had to be spent to produce electrical energy in A, so electrical energy will be spent in keeping up the stresses aroundA that tend to drive it out of the magnetic field. If the current in A were in the other direction the stresses in its field and that of the coil would be concurrent instead of opposed, and their resultant would tend to draw wire and coil together, *i. e.*, work would have to be spent to keep them apart. This is the broad principle of the electric motor. It is sometimes referred to as simply a reversal of the dynamo, but it really makes no difference whether the structure in which the action just described takes place is well fitted to generate current or not. Given a magnetic field and a wire carrying electrical energy, and there will be a force between them depending in direction on the directions of the electromagnetic stresses belonging to the two. If either element is arranged so as to move and still keep up a similar relation of these stresses we have an electric motor. Whether so arranged as to fulfil this condition with alternating currents, or in such manner as to require currents in one direction only, the principle is the same.

17. So far as unidirectional or "continuous" currents are concerned they are usually obtained from dynamo electric machines similar in principle to Fig. 8. This machine, if the ends of the winding on



FIGS. 8 AND 9.

the armature be connected to two metal rings insulated from each other, serves as a source of alternating currents which can be taken off the two rings by brushes pressed against them. If it is necessary to obtain currents in one direction only, this can be readily done by reversing the connection of the outside circuit to the windings at the same moment that the current reverses in them. The simplest way of doing this is by a "two part commutator," such as is shown in diagram in Fig. 9. Here A is the shaft surrounded by an insulating bushing. On this are fitted two half rings C and C′, of metal (the commutator segments). On these bear brushes B and B′. If the ends of the winding are connected to C and C′ and the brushes are so placed that they pass from one segment to the other at the moment when the current in the winding changes its direction, the direction of the current with respect to the brushes and the outside circuit with which they are connected will obviously remain constant.

18. In the actual practice of dynamo building very many refinements have to be introduced to serve various purposes, but the underlying principle remains the same, *i. e.*, to set up in a conductor electromotive stresses by dragging it into and out of the strained region of ether under an electromagnetic stress.

As the dynamo is intended for producing continuous or alternating currents its structure is somewhat modified with its particular use in view. These modifications extend not only to the general arrangement but to the details of the winding. Alternating dynamos usually have a more complicated magnetic structure than continuous current machines, and are almost invariably separately excited, *i. e.*, have their magnetizing current supplied from a generator specialized for producing continuous current. The magnetic complication is really only apparent as it consists merely of an increased number of magnet poles, due to the desirability of obtaining tolerably rapid alternations of current.

Dynamos designed for producing continuous current are modified with the armature as a starting point. The winding is very generally much more complicated than that of an alternator and the commutator that serves to reverse the relation of the windings to the brushes at the proper moment is correspondingly elaborate. The magnetic structure is usually comparatively simple. The whole design is necessarily subordinated to securing proper commutation. Continuous current dynamos are almost universally self-excited, that is the current which magnetizes the field is derived from the brushes of the machine itself. Whatever the character of the machine the electro-motive force generated in it increases with the intensity of the magnetic field (that is, the magnitude of the ether strains, which affect the armature conductors) with the speed (that is, the rate at which energy is expended in driving the conductors through the field) and with the number of turns of wire of which the electromotive forces are added. The capacity of the machine for furnishing electrical energy varies directly with the electromotive force and with the capacity of the armature conductors for transmitting the energy without becoming overheated. Practically all the energy lost in a dynamo appears in the form of heat, which must be limited to an amount which will not cause an undue rise of temperature.

It is not the purpose of this chapter to deal with the practical

details of dynamo design and construction. For these, the reader should consult special treatises on the subject, which consider it with a fullness which would here be quite out of place. Special machines, however, will be briefly discussed in their proper places and in relation to the work they have to do.

19. Having now considered the principles which underlie the transformation of mechanical into electrical energy we may profitably take up the fundamental facts in regard to the measurement of that form of energy and the units in which it and its most important factors are reckoned.

All electrical quantities are measured directly or indirectly in terms of the dynamical units founded upon the units of length, mass, and time. These derived dynamical units can serve alike for the measurement of all forms of energy so that all have a common ground on which to stand. As the electrical units are derived directly from the same units that serve to measure ordinary mechanical effects, electrical and mechanical energies are mutually related in a perfectly definite way.

20. A natural starting point in the derivation of a working system of electrical units may be found in electromagnetic stress, such as is developed about an electrical circuit or a steel magnet. To begin with, the mechanical units that may serve to measure any form of force are derived from those of length, mass and time. These latter are almost universally taken as the centimetre, gramme and second. C. G. S. system. Starting from these the unit of force is that which acting for one second on a mass of one gramme can change its velocity by one centimetre per second. This unit is called the *dyne* and as a stress it is equivalent to about one $\frac{1}{981}$ of a pound's weight on a unit pole one centimetre distant. This unit is inconveniently small for practical use and before long some multiple of it is likely to be given a special name and used for practical reference. Magnetic measurements may thus be made by direct reference to the dyne and centimetre.

21. Referring now to what has been said about the causes which vary the electromotive force produced in a dynamo, we fall at once into the definition of the unit electromotive force, which is that produced when field, velocity, and length of wire under induction are all of unit value. The unit electromotive force is, then, that which is generated in one centimetre of wire moving one centimetre per second, perpendicular to its own length, straight across unit field. This, too, is inconveniently small, so that one hundred million times this quantity is taken for the practical unit of electromotive force and called the *volt*.

The unit electrical current is that which flowing through one centimetre length of wire will create unit field at any point equidistant from all parts of the wire (as when the wire is bent to a curve of 1 cm. radius). One-tenth of this current is taken as the working unit and called the *ampère*.

The unit electrical resistance (one *ohm*) is that through which an electromotive force of one *volt* will send one *ampère*.

The C. G. S. unit of work or energy is unit force acting through unit distance, that is one *dyne* acting through one centimetre. As this is too small to be generally convenient, ten million times this amount is taken as the working unit (called the *joule*). This is a little less than three-quarters of a foot-pound (exactly .7373). The unit *rate* of doing work is one *joule* per second. This unit rate is called the *watt* and translating this into English measure, one *watt* equals $\frac{1}{746}$ *horse power*.

22. Although the watt is often spoken of as an electrical unit, it belongs no more to electrical than to any other form of energy. It only remains to show the relation of the *watt* to the more strictly electrical units just mentioned. Recurring to our definition of the volt, let us suppose that the resistance of the circuit of which the moving wire is a part is such that unit electromotive force produces unit current in it. The stress between the field of the moving wire and the other unit field through which it moves is one dyne. In maintaining this for one second at the given rate of moving (1 cm. per second) the work done is, as above, one C. G. S. unit. At this rate if the E. M. F. were 1 *volt* and the current 1 ampere, the work would be one *joule* and the rate of doing work one watt. If either E. M. F. or current were changed, the work would be proportionally changed. So, the number of volts multiplied by the number of amperes is numerically equal to the *watts*, *i. e.*, we have obtained the dynamical equivalent of the two factors that make up electrical energy as ordinarily reckoned. So the output of any dynamo in watts is determined by the volt-amperes produced, and we see the reason of the ordinary statement that 746 *volt amperes* make one horse power. This is always true whether the output is steady or variable, so long as we measure the product (volts and amperes) correctly.

What few other electrical units appear in practical work will be referred to in their proper places.

It has been the purpose of this chapter, not so much to set forth the ordinary elements of electrical study, as to present these elements as viewed from the standpoint of energy. The author has purposely avoided the conception of electricity as a material something, in favor of the idea of stresses in the medium producing strains which are propagated through the medium, thus effecting the transmission of electrical energy. Hereafter we shall have to do with the extension of this transmission to practical magnitudes, and its utilization in the development of human industry.

(To be continued).

Electrodynamic Machinery—XVII.

BY E. J. HOUSTON AND A. E. KENNELLY.

86. The type of curve represented in Figs. 64, 65 and 66, showing the E. M. F. generated by the rotation of a conducting loop in a uniform magnetic flux, may be produced by the rotation of the coil represented in Fig. 67. In practice, however, continuous current generators do not produce this type of E. M. F. Fig. 68 represents, in cross section, a common type of generator armature, situated between two field poles, N and S. The flux from these poles passes readily into and out of the armature surface as indicated by the arrows. In other words, the flux cuts the surface of the armature at right angles, while, in the cases shown in Figs. 57 to 60, the conducting loop is only cut by the flux at right angles in two positions 180° apart, so that the curve of E. M. F. is peaked at these points, and descends rapidly from them on each side.

87. Suppose in Fig. 68 that the difference of magnetic potential,

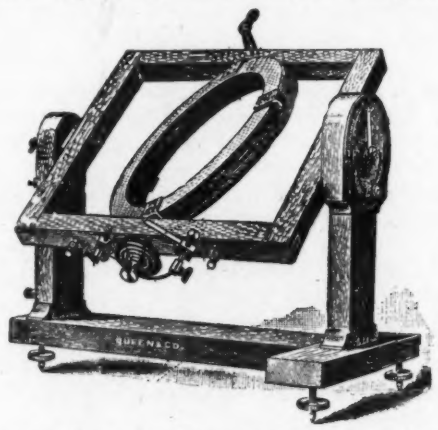


FIG. 67.—COIL FOR INDUCING FEEBLE E. M. F.'S BY REVOLUTION IN EARTH'S MAGNETIC FLUX.

maintained between N and S, is 2,000 gilberts, that the diameter of the armature core S O *h*, is 40 cms., that its length is 100 cms, and that the air-gap or *entrefer* is 1 cm., then, if the reluctance of the iron armature core be regarded as negligiblv small, the magnetic potential between the polar surfaces and the armature surface on each side, that is between *c* N *e* and A *g* B, also between *d* S *f* and A *h* B, will be 1,000 gilberts. The magnetic intensity in the air may be obtained in two ways.

(1) By considering the total reluctance of the air and obtaining the total flux through it. Thus the polar surface represented is 55 cms. in arc × 100 cms. in breadth = 5,500 sq. cms. The reluctance of the air-gap on either side of the armature is, therefore, $\frac{1}{5,500}$ oersted, and the total flux passing through the air will, therefore, be $\frac{1,000}{\frac{1}{5,500}} = 5,500,000$ webers. This flux, divided by the area through which it passes, gives the intensity or, $\frac{5,500,000}{5,500} = 1,000$ gausses.

(2). The magnetic intensity is, as we have seen (Sec. 46), the drop of magnetic potential in air, or other non-magnetic material per centimetre, so that the drop of potential being here 1,000 gilberts in 1 cm. of distance in air, the intensity must be 1,000 gausses. Representing the intensity graphically, as shown in Fig. 69, it will be seen that the intensity is uniform from *c* to *e*, and then descends rapidly to zero at B, where it changes sign and becomes negatively directed, and is then uniform from *f* to *d*, falling again to zero at A. The flux direction, therefore, changes sign twice in each revolution.

88. If a wire AB be wound as a loop around the armature, it will, when the armature revolves, cut this flux at right angles, and

will, therefore, have induced in it an E. M. F., which must be of the same type graphically as the curve in Fig. 69. Thus, if the surface of the armature moves at a rate of 50 cms. per second, the E. M. F. induced in the loop will be $2\,v\,l\,\mathfrak{B}$, the factor 2 being required, since both sides of the loop are cutting flux, one at A, and the other at B, or

$$2 \times 50 \times 100 \times 1{,}000 = 10{,}000{,}000 \text{ C. G. S. units} = 0.1 \text{ volt.}$$

except at the moment when the wires emerge from beneath the pole pieces. This curve is represented in Fig. 70, where the distance OF represents the time of one complete revolution of the armature, and the elevation of A corresponds to 0.1 volt. If the armature be set revolving at twice this speed, the time occupied in a revolution will be halved, but the E. M. F. being proportional to the rate of cutting flux, will be doubled, as represented in Fig. 71, where the E. M.

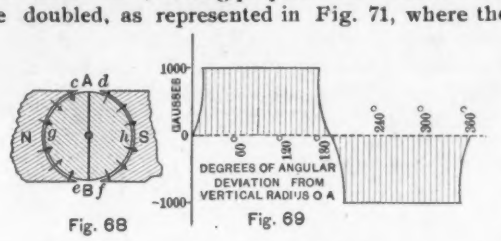


Fig. 68

Fig. 69

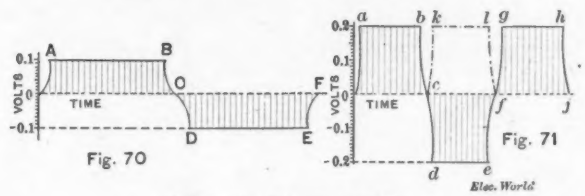


Fig. 70 Fig. 71

FIGS. 68, 69, 70 AND 71.

F. is alternately 0.2 volts in each direction. By the aid of a suitably adjusted commutator, the E. M. F. instead of changing sign can be kept unidirectional in an external circuit following the curve *o a b c k l f g h i.*

89. We may regard the E. M. F. of the loop as being induced either by the cutting of the flux by the wire at the armature surface, or by the enclosure of the flux by the loop. The flux enclosed by the loop is represented by Fig. 72, where at the initial position at AB, the loop encloses 5,500,000 webers. As the armature is rotated counter-clockwise, so that A is carried towards N, the flux enclosed by the loop diminishes, until, when it reaches the horizontal position, the flux through the loop is zero. As the rotation continues, the flux re-enters the loop in the opposite direction, and becomes 5.5 megawebers at a position 180° distant from the initial position AB. The

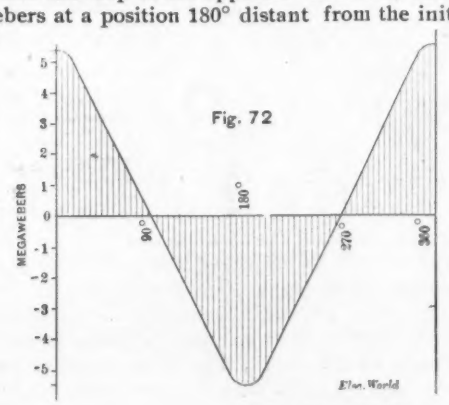


Fig. 72

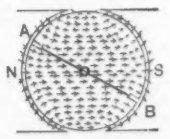


Fig. 73

FIGS. 72 AND 73.

rate of change of flux enclosed, or the gradient of the curve, shown in Fig. 72, is uniform, since the curve is uniformly steep, except near the position of maximum flux, where the gradient is considerably reduced, and the E. M. F. correspondingly reduced as already observed in Figs. 70 and 71.

90. When, however, the wire, instead of being on the surface of the armature is buried in a groove in the iron, as in a toothed-core armature (Sec. 17), and as shown in Fig. 72, then, since the wire cuts no flux, there being little or no flux at the base of the groove where the wire lies, it is necessary to suppose that the E. M. F. still induced in the wire by the rotation of the armature, is due to the rate of enclosing flux, and not to the rate of cutting flux, so that Fleming's hand rule cannot readily be applied. The following rule, will, therefore, be of assistance in determining the direction of the E. M. F. induced in a loop. If we consider that a watch dial is visible to the observer who holds it facing him, by the light which proceeds in straight lines from the watch to his eye, then the direction of the E. M. F. induced in a loop regarded as the outline of the watch face can be remembered by the following rule.

The induced E. M. F. has the same direction as the motion of the hands of the watch, when the flux entering the loop has the same direction as the light.

Flux entering the loop in the *opposite* direction will induce an E. M. F. in the *opposite* direction to the hands of the watch, that is, counter-clockwise.

A loop being emptied of flux will have an E. M. F. developed in it in the opposite direction to that which would be produced if the flux were entering.

(To be continued).

Notes on the Management of Railway Power Stations—VII.

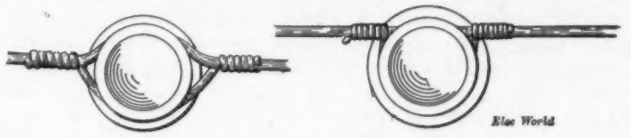
BY GEORGE T. HANCHETT.

The Line.

The construction of the distributing system of a railway power station, while usually planned and superintended by an engineer, depends for its maintenance and small additions upon the station manager and his corps of wiremen.

The average railway feeder is a heavily insulated stranded cable. It usually costs all the way from ten to fifty cents per foot, according to insulation, finish and size. When a management has gone to the expense of supplying heavy cables for reducing the loss on their feeders, there should be no joint admitted that is not mechanically and electrically equivalent to the body of the wire. A good joint on a railway feeder is a matter of several hours' labor. It will not pay to put poor work or expensive material. Start the joint by stripping the wire at least a foot from each end. In doing this whittle the insulation off and scrape clean. Do not cut around the wire with knife or plyers.

Hold the wire with the end pointing downward and with a brush thoroughly wet each wire with acid. Do not hold the wire in any other position till all the acid has been removed. If this caution is



FIGS. 18 AND 19.—METHODS OF TYING.

neglected, the acid will creep up the wire under the insulation and if any amount gets in among the strands it will corrode them and is liable to cut them off thereby.

Each wire should now be thoroughly tinned. This is best done by immersing each wire in a pot of melted solder and wiping off with a cloth damp with soldering acid. Do not rely on the tinning that may be on the wire. It is a help, but it is by no means sufficient. The tinning must be a thin, even coating of solder. It is not properly done if any lumps or thick layers are formed. If it is well done the joints will solder without acid.

Now make a twist joint between every strand with not less than four turns on each side. These joints should set along the main joint in line and not all in a bunch, thus making an unsightly lump of the finished joint.

Each joint should be thoroughly soldered. If a flame is used the wire should be hot enough to melt the solder with the flame removed before the solder is applied. Then and not till then apply with flame and solder. Thoroughly clean off all acid with a wet sponge and dry with a flame.

Paint the joint with P. & B., and when that is dry lay on a layer of tape, starting at the insulation, but not overlapping. Give the joint a second coat and start the next layer two or three inches back of the first one, overlapping the insulation. Paint this and put on a third layer, finishing with two coats of paint. Draw the tape tightly around the joint. If well done the joint should measure up less resistance than an equal length of continuous cable.

In tying never bend a kink in the line as in Fig. 18. The wire should be as in Fig. 19, and can be tightly held in that position. Insulators, such as are shown in Fig. 20, are much preferable to those shown in Fig. 21 for straight line work.

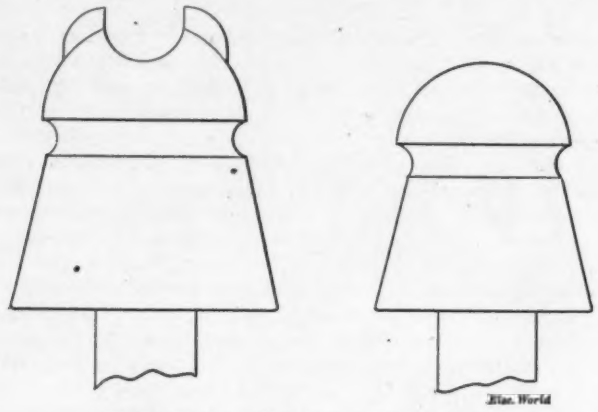
The insulator in Fig. 20 is in a position to support the wire. Fig. 21 is an idea which was very efficient with light wires and easy to construct and install, and as it is always hard for designers of construction material to break away from old ideas it is largely used for heavy feeders in cases where it is entirely unsuited. The strain of weight alone on a 0000 A. W. G. feeder on its insulator, is, roughly, one pound for every foot of span between poles.

The proper place for a beam is on top of its supporting column and not tied to the side with a wire, and heavy construction work should be laid out on the same principles.

Clamp insulators which avoid tie wires are very desirable. A heavy, well-designed insulator, comprised of two parts exactly alike and gripping with a suitable bolt, would be a great advantage. It would pay for its cost by the ease of its installation, the complete support it gives the wire and the freedom from abrasion. There are no heavy insulators of this type made.

Never screw an insulator on to an iron pin without first interposing cloth or paper. Insulators placed in winter without this precaution are sure to be strewn in pieces in the street on the ensuing summer, due to this fact that, iron expands almost twice as rapidly as glass.

In choosing insulators remember that symmetry is desirable, but that security and safety are the prime considerations. Where the



FIGS. 20 AND 21.—LINE INSULATORS.

pole line is of necessity crooked every pole may need a differently designed insulator from those on the poles adjacent.

The setting of a pole two or three feet out of line often results in a transverse strain of a hundred pounds or more on each insulator. If care and judgment as to the nature of the strain in each case is used, and the type insulator chosen to fit, the result may be unsymmetrical, but it is there to stay, which, after all, is the most important part.

The clamp insulator is here of great value, due to its all round utility in these cases. In line construction do not draw the wires any tighter than necessary to do the work properly and appear well. Many a trolley wire has dropped in the street for no other reason than that an excessive strain on the supporting wires by ratchet fasteners.

Guard wires depart from this rule from the fact that they do not carry the load when installed that they are destined to bear in service. They should therefore be much more tightly drawn than the rest of the construction. The guard wires should be completely insulated at their points of support or one-half of their value is gone.

Efficient lightning arresters on the poles save generators and motors. In a well constructed line, the lightning discharge should seldom reach either motor or station.

At the earliest convenience number each and every pole. Prepare a tracing of the whole line and hang blue prints of it in places where they can readily be inspected by linemen. Small prints with every run of poles marked with the highest and lowest numbers they contain should be issued to the foreman of every gang. The actual numbers of the poles should be painted upon them. By this means the inspector can locate exactly the needed repairs, describe them accurately to the lineman and keep a strict and intelligent account of the whole. Each lightning arrester and cut-out switch should be located on the large drawing. This system of numbering will not only facilitate line but track repairs as well. The use of letters will prevent the number from becoming inconveniently large. The track construction is a matter to which thought and design has been given, and only by severe and expensive lessons has the girder rail been evolved. It is very noticeable that after a great deal of capital has been spent in expensive material it is often ignorantly installed. The weak points of a track are its joints, frogs, plates and crossings, yet in constructing the line the average foreman seldom exercises any care as regards choosing ties to put under joints and sometimes he neglects to put one under at all.

A difficulty should be met on every side and while it is well to strive in the design of a truck to avoid the hammer blow, it is also wise to see that the joint is well supported by an exceptionally heavy tie and the earth especially well tamped around it.

The ground return next comes in for comment. There are two very popular subjects connected with it. First, the path of the current through the earth, and second. the energy lost in the return.

With regard to the first subject the writer believes that a little research and experiment would result in great savings.

If an electromotive force is applied to a homogeneous mass of metal the current will not fill it uniformly and flow from point to point.

Connect to the corners of a square tin plate the terminals of a storage cell and pass twenty or more amperes through it. With the terminals of a delicate galvanometer determine points of the same potential. The equipotential points will be found to differ very considerably from what geometrical conditions would suggest.

How much more then will a ground circuit, through a mass anything but homogeneous in its nature, deflect the current from its theoretical directions.

Heavy copper is often laid along street railroad tracks made to protect pipes at a distance of twenty or more feet from the damaging effects of electrolysis. In order to protect a pipe the copper should be laid near the pipe rather than the track.

The writer believes that a great many cases where heavy copper ground returns have failed to check electrolysis, have failed not because insufficient cross sections of return has been provided, but because it had an excessive resistance due to its length.

In Fig. 22 is shown a pipe system and a railway ground return. The current flows into the pipe system in large quantity, not because its resistance is less per thousand feet, but because the total resistance of the pipe is less, due to the short length across A B. The current takes this short cut to the station and the pipe would be protected by a copper wire of very moderate cross section run across A B, because the pipe line has an increased resistance due to poor electrical joints and the earth gaps at each end. If the ground

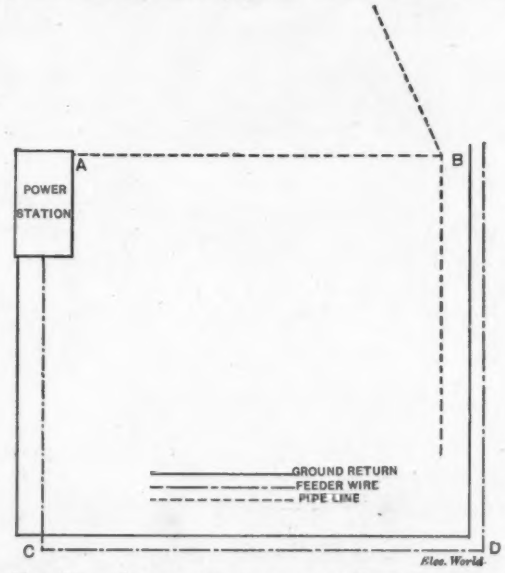


FIG. 22.—GROUND RETURN AND PIPE SYSTEM.

returns were planned as carefully as the overhead system, proportionately better results would be obtained. The following principle should be carefully borne in mind. *The ground return wires, if any are used, do not always give the best results laid in line with the track.* Lay them out in accordance with Ohm's law as if the earth were an insulator and the best results will be obtained.

It is not possible to protect a pipe system by simply remodeling the electric circuits at the points where the damage is done. A study of the whole system, both pipe and electric, must be made before an intelligent remedy can be applied.

The electrical energy at the station is readily measured, but the drop between the different points of the system from bus-bar to bus-bar is none the less important to determine. Measurement will disclose a drop in the trolley and car wheel contacts as well as in the feeder system and ground returns. In any event in planning a feeder system, feed from the middle and utilize the loop circuit wherever possible. Remember that while the resistance varies inversely as the cross section that that is the expensive way of reducing it. Resistance also varies directly as the length and by thus reducing it you realize a double gain. You reduce the resistance and use less copper rather than reduce and use more copper. There-

fore, be quick to utilize all short cuts to the station, and remember that while property owners might object to a heavy pole line in front of their houses they would be unreasonable indeed should they object to a buried ground return. Lastly bear in mind that it is by no means necessary and often disadvantageous to follow the car track with your copper both above and below the ground.

(To be continued.)

Practical Notes on Dynamo Calculation.—XVIII.

BY ALFRED E. WIENER.

In equation (98) the length, L_e, of effective armature conductor depends upon the polar embrace, which, in turn, is determined by the ratio of the distance between pole corners to the length of the air spaces; and can be expressed in terms of the total active length of wire, by

$$L_e = L_a \times \beta \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (99)$$

Inserting (99) into (98) we obtain the actual field density:

$$\mathfrak{C} = \frac{b \times E \times 10^8}{72 \times \beta \times L_a \times S} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (100)$$

where $\mathfrak{C}$ = Actual field-density of dynamo, in lines of force per square inch;
b = Number of bifurcations of current in armature;
E = Total E. M. F. to be generated in armature, in volts;
β = Percentage of polar arc; see chapter 34.
L_a = Length of active armature conductor, in feet, formula (3), or (101);
S = Conductor-speed, in feet per second, formula (5).

Since, in a newly designed armature, on account of rounding off the number of conductors to a readily divisible number, and the length of the armature to a round dimension, the actual length, L_a of the armature conductor, in general, is somewhat different from that found by formula (3), (as a rule, a little greater a value is taken) it is preferable to deduce the accurate value of L_a from the data of the finished armature:

$$L_a = K \times \frac{la}{12} = \frac{o \times u}{p} \times \frac{la}{12}, \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (101)$$

where K = Total number of conductors on armature;
l_a = Length of armature core, in inches;
o = Number of wires per layer;
u = " " layers of armature wire;
p = " " wires stranded in parallel.
} see chapter 9.

Formula (100) for the actual field density of toothed and perforated armatures, can also be used for smooth cores, and may be applied to check the result obtained from (96).

For the application to smooth armatures, however, the polar embrace β, in formula (100), is to be replaced by the corresponding value of the effective field circumference, β', obtained from the former by means of Table XXXII, chapter 20.

If it is desired to know the real field area in toothed and perforated armatures, an expression for A_f can be obtained by combining formulae (93) and (100), thus:

$$A_f = \frac{\Phi}{\mathfrak{C}} = \frac{72 \times \beta \times L_a \times S \times \Phi}{b \times E \times 10^8} \quad \ldots\ldots\ldots\ldots (102)$$

This formula, which gives the mean effective area actually traversed by the useful lines cutting the armature-conductors, is very useful for the investigation of the magnetic field of toothed and perforated armatures.

34.—Percentage of Polar Arc.

The ratio of polar embrace, to which frequent reference has been had, in Section 33, is determined as follows:

(*a*) *Distance Between Pole-corners.*

The mean distance between the pole-corners, e_p, Fig. 47, is decided upon according to the rule alluded to in chapter 33, viz., the rule of making that distance from 1.25 to 8 times the length of the two gap-spaces, according to the kind and size of the armature and to the number of poles, see Table XLVII.

Denoting this ratio of the distance between the pole-corners to the length of the gaps by k_{11}, this rule can be expressed by the formula:

$$e_p = k_{11} \times (d_p - d_a), \quad \ldots\ldots\ldots\ldots\ldots\ldots (103)$$

where d_p = diameter of polepieces, in inches;
d_a = diameter of armature-core in inches; for toothed and perforated armatures, d_a is the diameter at the bottom of the slots.

The value of k_{11} for various cases may be chosen within the following limits:

TABLE XLVII.—RATIO OF DISTANCE BETWEEN POLE-CORNERS TO LENGTH OF GAP-SPACES, FOR VARIOUS KINDS AND SIZES OF ARMATURES.

Capacity, in Kilowatts.	Value of Ratio k_{11}					
	Smooth Armature.				Toothed or Perforated Armature.	
	Bipolar.		Multipolar.			
	Drum.	Ring.	Drum.	Ring.	Bipolar.	Multipolar
.1	1.5	2.5	1.5	2.5	1.25	1.25
.25	1.75	3	1.75	2.75	1.5	1.3
.5	2	3.5	2	3	1.75	1.4
1	2.25	4	2.25	3.25	2	1.5
2.5	2.5	4.5	2.75	3.5	2.25	1.6
5	3	5	3	3.75	2.5	1.7
10	3.5	5.5	3.25	4	2.75	1.8
25	4	6	3.5	4.25	3	1.9
50	4.5	6.5	3.75	4.5	3.25	2
100	5	7	4	4.75	3.5	2.1
200	5.5	7.5	4.25	5	3.75	2.2
300	6	8	4.5	5.25	4	2.3
400	....	....	4.75	5.5	....	2.4
600	....	....	5	5.75	....	2.5
800	....	....	....	6	....	2.6
1,000	....	....	....	6.5	....	2.7
1,200	....	....	....	7	....	2.8
1,500	....	....	....	7.5	....	2.9
2,000	....	....	....	8	....	3

Whenever k_{11} can be made larger than given in the above table without reducing the percentage of the polar embrace below its practical limit, it is advisable to do so, and in fact, this ratio in some modern machines has values as high as $k_{11} = 12$.

(To be continued.)

A Poetical Warning.

According to London *Lightning*, a recently appointed assistant manager in a central station posted up the following notice:

NOTICE TO ENGINE DRIVERS.

One hot bearing!
A hard swearing!
Two!
Adieu!

Temperature of the Ocean.

The temperature at the bottom of the Atlantic Ocean, as determined by the resistance of the Atlantic cables, is said to be 2.8° C, which is a mean for the whole year. That at the bottom of the Mediterranean, measured in the same way, is said to be 13.8°.

Fly-Wheel Accidents in Power Houses.

To the Editor of The Electrical World:

Sir: Reading the very interesting and instructive correspondence which your later issues have brought out, relative to the breaking of fly-wheels, I note that one of your writers states, on page 500, apparently controverting my own earlier statement, that the cases which I had known were those of engines with detachable gear, in which some defect had occured in the governor or its connections.

I had no intention of denying the liability to accident of engines with positive motion gears, and had seen accounts of the cases which he quotes, In the latter instances, however, I had not usually, known enough of the individual cases to judge precisely what was the cause of the disaster. My point was that the majority of the cases in which the cause was indisputably discovered, were instances of defective governing primarily. The difference between the detachable gear and the positive motion shaft system of governor and gear is that the accident to the governor of the former throws the steam into the engine full-stroke; while in case of accident to the latter, the steam is usually shut off entirely; with the former a "runaway" is the natural and probable result, with the latter a sudden stop.

With defective wheels no class of engine is absolutely safe; but the large wheels of slow engines are more liable to serious and dangerous defects; they usually govern less closely, and hence, if at or near the danger line at normal speed, they are more liable to pass it even without accident to the governor; they are more sure to reach it if such accident does occur. The high speed engine, with shaft governor, is likely to have a sounder, because a smaller, wheel, on the average; it usually governs more closely, and is thus more certain to keep inside any near limit of strength of wheel, and, in case of injury to the governor, as a rule, unquestionably, reduces danger to zero, instead of exaggerating it.

Mr. Flather, on page 498, refers to what I have no doubt is a not

infrequent source of danger and an occasional cause of accident—the shrinkage strains, which always exist, to some extent, and often to a serious and dangerous extent in large castings. It is but a short time since I saw a high-speed engine, in a light and power station, working, apparently, to the satisfaction of the manager, with one arm of its wheel broken, and the faces of the break visibly separated, by its own shrinkage-stresses. It was finally removed, but not until a new wheel was made and received from the builder, some time after the break was discovered; meantime, the wheel had done good duty, in its fractured condition, on a very trying street-car system. No one would be likely to advise this sort of risk being taken; but the fact illustrates the case well, and shows how enormous must sometimes be these internal stresses and strains in castings too rapidly or irregularly cooled, or when badly designed.

I once designed a 16-foot fly-wheel, in halves, for a Greene engine; it was cast some time before it was needed, and was stored in the yard one midwinter day, where it lay in shadow in the early morning, in sunlight at noon. One bright, cold morning, when the sun shone clearly and its rays were unusually warm, the half-wheel lying on top its mate, and probably very cold, received the full heat of the sun's rays, as the shadow swept off its rim, and, after an hour or so, the exact time was not known, the centre and arms dropped out of the rim, with a sharp report, and the wheel was ruined. It had been cooled at the foundry too rapidly. Had it been set at work it is possible that the added load would have been just sufficient to inaugurate a wreck. Norman Wiard, in promulgation of his ideas of ordnance construction, used to place before the committees of Congress castings designed in such manner that they would inevitably be broken by these shrinkage-stresses.

In another case we fitted a heavy engine with a cast iron crank. It dropped off, broken at the hub, the first time the engine turned over. A new crank from the same pattern, but with special care taken in cooling in the foundry, was put in its place, and is running, I presume, to-day, having performed years of service.

It must not be supposed that I would advocate discarding the detachable gear, and the universal use of a positive-motion system, with a shaft governor. A throttling engine is probably more subject to this danger than either of the others; but I have often advised its use, and have designed such engines for special purposes. What I would advise, however, would be the construction of large wheels for such engines, as is, in fact, usual, in segments, and the taking of special precautions, as by insuring a very heavy head of metal when pouring them, and by as slow cooling as is customary with cast iron ordnance, to insure soundness and freedom from shrinkage-stresses. Some safety device should be employed with all such valve-motions to insure shutting off steam at a fixed and safe limit of speed, and all possible precautions in design, as well as in construction and operation. These precautions, however, would not be out of place with any class of engine.

I presume that defective castings are responsible for many breakdowns; but the stronger the wheel, the worse the wreck when a runaway does happen, and insurance against overspeed and defective regulation must be the main reliance as a preventive of the majority of these startling, costly, and often fatal accidents.

Ithaca, N.Y. R. H. Thurston.

To the Editor of The Electrical World:

Sir: The letter of Mr. Coykendall calls attention to the stresses induced in a fly-wheel by sudden application of a large load to the engine, and the sudden removal of the same. The serious character of this stress has, I think, been long recognized by engineers, and provision is usually made to make the wheel sufficiently strong to resist the action of centrifugal force and also the stresses due to sudden application of the load.

I have seen no exact statistics relating to fly-wheel accidents; I know that such accidents occasionally happen, but it is my belief that considering the number of steam plants in use, the percentage of fly-wheel accidents is not greater on engines driving machinery for electric railroads, than on mill and factory engines. These accidents have been more or less common ever since the use of the steam engine,* and I do not consider the percentage greater than heretofore. This again leads me to think that the stresses referred to are as a rule well considered and provided for by builders of engines for street railway purposes.

The two forces which act to destroy fly-wheels may be considered as centrifugal force and inertia. When the fly-wheels are used as belt wheels an additional force equal to the difference of tensions on the two sides of the belt, exerts a transverse strain on the arms, and tends to flex and rupture them. This force suddenly and intermittently applied may induce a vibration which in connection with centrifugal force tends to rupture the wheel.

Approximately the centrifugal force depends only upon the radius, angular velocity and specific weights of the material.* For cast iron moving with a lineal velocity of V feet per second, the centrifugal force $= 0.0971\ V^2$ per square inch of section of rim. So that the stress in fly wheel per square inch of rim due to centrifugal force, would be as follows:

Velocity of rim, feet per second...	30	40	50	75	100	150	200
Centrifugal force per sq. inch....	87.4	155.3	242 8	546.3	971 0	2185 2	3,884 0
Velocity of rim feet per minute ..	1,800	2,400	3,000	4,500	6,000	9,000	12,000

As the breaking strength of cast iron is from 16,000 to 22,000 pounds, it is seen that the limit of strength is not reduced until the velocity of rim reaches about 400 feet per second, or 24 000 feet per minute. Allowing a factor of safety of 5, the greater safe speed is reduced to 200 feet per second, at which velocity small wheels could no doubt be run safely.

The strains on the arms of the fly-wheel are caused by variation in speed, in which case the inertia of the wheel tends to produce transverse rupture; also by the transmission of the load from axle to periphery which produces a strain of the same nature.

These forces tend to flex the spokes, and if the sum of these transverse forces is too great, rupture of the arms is the result.

As the twisting movement is transmitted from the rim to the shaft of the arms, it is evident that these jointly should be of strength equal to that of the shaft. If the shaft is of wrought iron, the arms of cast iron, this condition will be brought about when the stress in the shaft is one-fourth of that in the arms.* If Z represents the modulus of section of the arm, d the diameter of the shaft and n the number of arms,†

$$\text{Then } Z = \frac{4}{5}\frac{d^3}{n}$$

The value of Z for simple sections would be as follows:

Rectangle $Z = \frac{1}{6}\ bh^2$; b = dimension at right angle to plane of wheel.

Circle $Z = 0.0982\ d^{13}$; d'' = diameter of arm.

Ellipse $Z = 0.0982\ ba^2$; b = axis at right angle to plane of wheel.

Table giving Dimensions of Arm, Equal in Strength to Shaft.

Diameter of Shaft.	Diameter of Circular Arm.	Axis of Elliptical Arm.	No. of Arms.
4	4 01	2× 5.6	8
6	6 06	3× 8 5	8
8	8.08	4×12.8	8
10	10.01	5×14 2	8
12	12.01	6×17.0	8
16	16.02	8×_5 6	8

This letter has no doubt taken a line somewhat foreign to that suggested by Mr. Coykendall, the desire being to show that the stress to which he refers is one that has never been neglected in a good design, and that a fly-wheel properly designed is safe so far as centrifugal forces are concerned and equally strong in arms and shaft.

The accidents which have come to fly-wheels are much varied in their nature; usually they are due to accident to the governor which permits the speed to accelerate to such an extent that the centrifugal force becomes sufficient to rupture the wheel; oftentimes they are due to defects in materials or to faulty construction of the wheel itself. In one case, with which the writer was acquainted, the accident was caused by a defective shaft.

If the arms of the wheel are made light, if the load is such as to cause considerable variation in speed, the accident may begin by breakage of the arms. In many wheels, especially large ones, molecular strains, due to unequal cooling at the time of casting, often exist, and the arms frequently are in a state of high tension and ready to give at the first severe strain. Such wheels are always a source of danger, and a menace to life, limb and property. While it may not be possible to determine the force which may be stored in by molecular strains existing in the cast iron arms by ordinary inspection, still the writer believes that a close examination at frequent intervals, would often detect flaws and imperfections which later might cause serious accidents. Sectional or built-up wheels are free from molecular strains and less likely to disintegrate than solid ones, but otherwise are not so strong. Large wheels of necessity must be constructed in this way, and for many years, 88 feet per second, or one mile per minute, has been considered about the highest safe limit of peripheral velocity. This limit has been exceeded in several instances, but recent fly-

*See paper by Herr Kochy, in the "Verhand des Vereins zur Beforderung des Gewerbfleisses," in 1886.

*Unwin Machine Design, Vol. II.

†Unwin's Machine Design, Vol. II., page 186.

wheel accidents indicate that we have not yet learned to build so strong that we can safely establish a higher limit.

The accidents with fly-wheels have occurred with that class of engines having slow rotative speed more frequently than with the high speed engines. This may be due to two causes; one, the need of a large driving pulley, which is more difficult to construct than a small one; second, the same absolute variation or increase of a given number of revolutions in speed causes proportionately a greater increase in centrifugal force in the slow speed than in the high speed engine. It is also quite certain that the governors applied to high speed engines are in general less liable to accident and regulate closer than those applied to the other type of engine. It should not be overlooked, however, that nearly all the heavy and powerful engines are of the slow speed class, and larger strains must be met in the fly-wheels.

This letter states quite fully my ideas regarding the general subject introduced by Mr. Coykendall, although for the reason stated other points relating to the failure of fly-wheels have been considered. I may say in conclusion that while I think every precaution should be adopted, in the way of design, construction and inspection, to prevent fly-wheel accidents, I do not think present practice to be such as to cause alarm, or misgiving, or lack of confidence in the engines now constructed by our best builders and used for driving railway generators.

Ithaca, N. Y. R. C. CARPENTER.

To the Editor of The Electrical World:

Sir:—I would like to add a word to the already extensive discussion on "Fly-wheel Accidents," in your columns. A large number of more or less plausible theories have been advanced for the breaking down of fly-wheels under conditions of an overload suddenly thrown on the engine, but it is doubtful to my mind if many of them will hold good for a wheel that is properly designed. Such a wheel will not be overstrained by any amount of steam admitted into the cylinder under the conditions given. I agree with Mr. Emery in saying that such accidents are due altogether to excessive speed, though not necessarily involving improper action of the governor.

There is another and, I think, potent cause for such accidents in railway power houses.

A common practice in the construction of such plants is to drive one or two dynamos from one engine, the plant consisting of two or more such units, with all dynamos in multiple. With such a combination it is possible through careless handling of the generators, or through accident, to cause any one of them to run as a motor, taking power from the other generators in multiple with it. Such a motor, if the field is weakened sufficiently by increasing the shunt resistance or breaking the shunt circuit altogether, which may happen, will easily attain power and speed high enough to be dangerous, not only to the fly-wheel of the engine coupled to it, but to its own armature and the armature of its sister dynamo. Under such conditions the engine governor is powerless to check the increasing speed, once the balls have reached their extreme outer position.

It is easy to imagine how such a thing could occur in the average power station. Suppose the load increasing, and it becomes necessary to put in a fresh unit. The engine is brought up to speed. The dynamo attendant adjusts his voltage to that of line (or thinks he does). But it so happens that the E. M. F. of the fresh dynamo is too low when he closes the switch. The result is a large deflection on the ammeter. The attendant, unless he is cool-headed, immediately adjusts his shunt rheostat violently, and most likely will turn it the wrong way. By this time there is a squealing of belts, the ammeters are demoralized, and the man crazy. As a last resort he will throw the switch on the face of the rheostat and break the shunt circuit through the lamps. (Why dynamo builders put a switch in the shunt circuit is more than I can understand. It is a source of the greatest danger, and altogether unnecessary).

When this switch is thrown the armature acts as a short circuit of low resistance through which the other dynamos send a powerful current and the violence with which such an armature gathers speed can hardly be imagined by any one who has not had an experience of this kind. A great many switch-boards, especially the boards built some years ago, are very deficient in their equipment of instruments. It is a common thing to throw dynamos in multiple by noting the relative brightness of the pilot lamps. Frequently even this precaution is neglected, and guesswork alone used. Under such circumstances it is a wonder so few accidents of this kind occur. R. FLEMING.

U. S. Navy Yard, N. Y.

Designing Electric Light Stations.

To the Editor of The Electrical World:

Sir: Why is it that when an electric light company is organized, the first thing they do after receiving their charter is to secure the services of an architect to draw up plans for the plant? Do you suppose that if a man needed a pair of shoes, he would get a carpenter to make them for him? Practically it amounts to the same thing.

But this is not the worst of it. Quite often, when a company finds it necessary to build a larger station, they get an architect to make plans for the building after the idea of the president, secretary or manager of the company, who are not electricians or mechanics, and know nothing of the requirements of such a building.

The writer of this was recently called upon to take charge of an electric light plant as superintendent and electrician. The plant was intended to be operated by water power, but had a steam engine and boilers, to be used in case of scarcity of water. The chimney was at one side of the dynamo room, and the enigne was placed right next to the chimney.

I noticed that when the engine was running the slight lateral motion of the main driving bolt caused it to run against the chimney. Inquiry elicited the fact from the engineer that if the original plans had been followed the chimney would have had to be cut away fully eight inches to allow the passage of the belt. The mistake had been discovered too late to permit their doing more than moving the engine out just barely enough to allow it to be run as stated above. Measurements for the foundation of the engine, shafting, etc., had been made by the secretary of the company, who, although an excellent secretary, could not by any stretch of the imagination be called a mechanic or an electrical engineer.

I might also state that while the dynamo room was a model of neatness, and furnished with the best of electrical apparatus and appliances, the soul of the plant—the boiler room—was about one of the worst holes I have ever come across. The boiler room and coal shed were one room, and there being only capacity for about 30 tons of coal, when a car of coal was unloaded the fireman had to crawl about over the coal pile to do his firing.

This is only a sample of several plants of the kind that I have seen. How much money and trouble could be saved if when a company is preparing to erect its plant, it would secure the man who is to have charge of the plant when finished, and let him design the plant, or else engage a constructing engineer for that purpose.

Cincinnati, O. C. H. CARTER.

Signalling Through Space.

To the Editor of The Electrical World:

Sir: I notice in your issue of Nov. 17, an article on the above subject by Mr. Thos. D. Lockwood.

Some time ago, in a small city in Maine, I was experimenting with a set of magneto telephones, using as a circuit, one side of the alternating electric light mains (at that time dead), and the ground as a return. There was no telephone line within a distance of two hundred feet, and, at times, I could distinctly understand parts of conversation which, I afterwards learned, was carried on over the telephone company's lines in that place.

As there was no possible chance for connection between the two circuits, this was evidently an example of induction, and there seems but little doubt that some time in the future, we will be able to converse with cities some miles distant, without any electrical connection whatever.

New York, N. Y. BENJ. O. ELLIS.

Continuous from Alternating Currents.

To the Editor of The Electrical World:

Sir: I have 300 cells of gravity battery and by a very simple arrangement can pass the full current through the primary of an induction coil and produce a direct current in the secondary circuit. Would a direct current dynamo give the same result as the battery, and if so, would it have any commercial value for long distance transmission? ELECTRICIAN.

New York.

[The character, not the origin, of the current, is the point always to be considered, and in this respect there is an identity in the case referred to. Such an arrangement, if practical, would have a considerable value for various purposes. Several different methods have already been devised to produce continuous from alternating currents, notably that of Pollak, described in The Electrical World of August 5, 1893, and later in a paper read before the International Electrical Congress at Chicago.—ED.]

DIGEST
OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Cathode Rays.—An editorial in the Lond. "Elec. Rev.," Nov. 2, reviews an article by Mr. Poincaré on the recent investigations of Lenard on the properties of cathode rays. He believes that the experiments show that the theory of Crookes regarding radiant matter—according to which the rays consisted of molecules of gas whose free path had been enormously extended by the rarefaction of the gas—was false and they also throw considerable doubt on the validity of the kinetic theory of gases. Mr. Lenard's experiments showed that the cathode rays could be generated only in a highly rarefied media, but would propagate themselves in a different medium like air at atmospheric pressure; when they were intercepted by glass they would not pass through it, but they would pass through a sufficiently thin piece of aluminum foil about 0.0025 mm thick; the thinness of the plate is the only essential condition, as conductors and dielectrics then behave alike; they show that the hypothesis of radiant matter is entirely at fault; the rays do not propagate themselves in a straight line but turn round opaque bodies; the degree of permeability of different gases was measured at different pressures; the degree of disturbance is due only to the density of the gaseous medium, its nature not being of any importance; cathode rays correspond to luminous rays of different colors and differ in their capacity for generating phosphorescence; a magnet acts as a prism which separates the different rays; the deviation of the same beam is the same in all cases and under all pressures; the phenomena is due to the luminiferous ether; the disturbance which the molecules produce depends on their mass alone.

Waves on Iron Wires.—A paper by Mr St. John on "Wave Lengths of Electricity on Iron Wires" (Jefferson Physical Laboratory) is contained in the "Phil Mag." for November. He investigates the question whether the magnetic qualities of iron are called into play under extremely rapid alternations of the magnetizing forces; he describes experiments made by himself and comes to the following conclusions: "The self-induction of iron circuits is greater than that of similar copper circuits under very rapid electric oscillations (115×10 to the sixth power, reversals per second). The change in self-induction varies from 3.4 to 4.3 per cent. in the present investigation and decreases with decreasing diameters. The increase in self-induction produces greater damping and a shortening of the wave length of 1.5 to 2 per cent. The permeability of annealed iron wire under this rate of alternation is about 385. For oscillations of the same period the wave length along parallel copper wires varies directly with the diameter of the wires. The maximum decrease observed in 5 per cent."

The same issue contains a paper by Prof. Trowbridge, "On the Change of Period of Electrical Waves on Iron Wires;" he states that his results were confirmed by those of Mr. St. John (in the above paper), who has shown by an entirely different method that the wave lengths sent out by the Hertzian vibrator on iron wires differ in length from those transmitted on copper wires of the same geometrical form as the iron wires.

Elliptically Polarized Rays.—A short article by Mr. Zehnder from the "Wied. Ann.," No. 11, 1894, is published in the Lond. "Elec.," Nov. 2. Elliptically and circularly polarized rays of electric force were to be obtained by two wire gratings, like those employed by Hertz by a process described in the article.

Energy of the Amperian Molecule.—A paper by Prof. Chattok and Mr. Fawcett is contained in the "Phil. Mag.," for November; they describe experiments undertaken for the purpose of determining if possible whether the molecular currents of ampere are accompanied by motions of the molecules themselves, and conclude among other things that "if the molecular currents are due to a spinning motion of ionic charges, this motion is not inseparably connected with the spinning of the molecules themselves."

Self-induction of a Ring—A paper by Mr. Hicks is contained in the "Phil. Mag.." for November; he solves the problem by means of toroidal functions and comes to a conclusion which does not seem to have been noticed before; the paper is highly mathematical in character.

Thermo-couples of Metals and Solutions.—An article by Mr. Hagenbach is abstracted at some length in the "Elektrochem. Zeit.," for November; he gives the results of a number of investigations

Surplus and Deficit Theory of Electricity.—The article by Mr. Maycock is continued in the Lond. "Elec. Eng.," Nov. 2.

MAGNETISM.

Magnetising and Astaticizing Galvanometer Needles.—A new, simple and very effective method is described with illustrations, by Mr. Wadsworth (of Washington) in the "Phil. Mag.," for November. He states that the sensitiveness of the galvanometer depends on the method of magnetization to a much greater degree than is usually supposed and by using this new method the sensitiveness may be doubled and in some cases more than quadrupled. The method consists essentially of placing the completed frame carrying an unmagnetized needle in two opposite air gaps of a single magnetic circuit, of a rectangular shape with coils surrounding two of the sides, the needles being in the air gaps; the two air gaps being both in the same magnetic circuit, the fields in the mare necessarily of precisely the same strength for all magnetizing forces, which is an essential condition for securing astaticism; the strength of the field should be suddenly increased to a maximum and then gradually decreased several times in succession, by varying the current, or better by varying the distance between the two poles and tapping the support with a light hammer when the magnetic induction is at its maximum, but in no case should the current be broken suddenly when the poles are close the needle or the strength of the latter may be very considerably weakened, if not totally destroyed; he describes the method very fully, giving also other precautions; in one case the sensitiveness of a galvanometer was increased fully ten times by remagnetizing in this way; another advantage is that in the construction only unmagnetized needles have to be handled.

Conductivity of Bismuth in Magnetic Fields.—A paper by Mr. Henderson, accompanied by a number of tables and plates of curves is given in the "Phil Mag.," for November. He gives a review of the subject with reference to previous publications and describes his experiments made to determine definitely the relation between the magnetic field and the resistance of bismuth wire, carrying it to much higher field intensities than have heretofore been used, and also to determine the influence of temperature on this relation, which influence is quite great and for exact determinations, it must therefore be known; a spiral of copper or platinum, side by side with the bismuth spiral, can be used to determine the temperature by the change of its resistance; the tables and curves appear to be very complete and are probably the most reliable that have been published; the intense fields were produced by the magnet of Prof. du Bois.

Changes of Length Due to Magnetization.—The results of some experiments by Mr. Nagaoka from the "Wied. Ann.," are given briefly in the Lond. "Elec.," Nov. 2. The experiments were made with iron nickel and cobalt; their behavior was fundamentally different; in the iron the length increased gradually at first with increasing field intensity, then more rapidly, reaching a maximum at 240 C. G. S. units, after which it fell below its original value, having reached the latter at 305; the maximum elongation was between four and five millionths of the length; the nickel showed no elongation, but a shortening approaching a limiting value at higher intensities; cobalt showed an exactly opposite behavior to iron; for all three metals the change of length appears to have an approximately linear relation to the square of the magnetization.

Leakage Between Conical Poles.—In the "Elek. Zeit.," Nov. 1, Dr. Weber gives an illustrated description of the application of the Quincke method for determining the value of the field between the poles of powerful electro-magnets ending in slightly truncated cones; he shows that this field is not uniform as is often supposed and gives the results of some measurements; the method is based on the action of the field in liquids in capillary tubes.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Inductance in Aerial Lines.—In the mathematical article by Prof. Blondel begun in "L'Eclairage Elec.," Oct. 20, he deduces the formulas for polyphase currents and compares the different alternating systems with respect to the inductance, a comparison which, he says, has not yet been made; he discusses, first, monophase lines, then polyphase lines, giving the general and the particular formulas.

Measurement of Compounded Resistances.—In a mathematical article by Mr. Campbell in the Lond. "Elec.," Nov. 2, he deduces a solution for the following case: In measuring the insulation resistance of the two leads in the wiring of a house, three measurements may be made, first from lead to lead, and then from each lead separately to earth; in some cases the former is equal to the sum of the two latter, but this is by no means necessarily the case, which he shows by an illustration; he then solves the general case of three resistances inseperably connected in the form of a triangle, in which it is required to find each of the resistances from the measurements taken between each of the three junctions; he gives both the algebraic and a simple graphical solution and shows that the real resistances are greater than the observed, giving the formulas. He shows how these solutions may be applied to any three or more resistances joined permanently in series in closed circuit when only the junctions are accessible, thus the resistance of

each separate coil of a closed circuit armature may be found by means of an ammeter and a voltmeter, an illustration of which is given.

Localizing High Resistance Faults in Submarine Cables.—Mr. Taylor, in the Lond. "Elec. Rev.," Nov. 2, replies briefly to Mr. Jones' article (see Digest last week), but intimates that it is tedious and impracticable, as the time for making such observations is of necessity very limited.

Photometric Units and Quantities.—In the abstract under this heading in the Digest last week, the following typographical error occurred: the letter Q should be inserted before the expression "for quantity of light of lighting" near the end of the paragraph.

Symbols.—The Lond. "Elec. Rev.," Nov. 2, replies editorially to the remarks in The Electrical World of Oct. 13, regarding Prof. Jamiesen's criticism; it claims that the matter is still open for discussion as the Congress did not adopt the Hospitalier system, but merely recommended it; it also claims that the discussion was not a truly international one.

Registering Ampere and Voltmeters.—An illustrated description of a new form containing a d'Arsonval galvanometer and a revolving drum, is illustrated and described in "L'Energie Elec.," Nov. 1.

Meter.—A well illustrated description of the Continental Co.'s meter, is given in "L'Eclairage Elec.," Oct. 20; it consists essentially of an electric dynamometer and an electric motor, a damping cylinder and an integrator.

Ayrton-Mather Galvanometer.—The new form already mentioned in these columns, is described and illustrated in the Lond. "Elec. Rev.," Nov. 2; it is based on the d'Arsonval principle.

Government Standardizing Station at Switzerland.—According to the Lond. "Elec.," Nov. 2, the question of establishing a State electrical standardizng and testing station in Switzerland, is under consideration.

Board of Trade Laboratory.—The Lond. "Elec. Rev.," continues its description in the issue of Nov. 2, in which the pressure standard (already mentioned in the Digest) is described and illustrated.

DYNAMOS AND MOTORS.

Design of Large Alternators.—In the Lond. 'Elec. Rev.," Nov. 2, Mr. Armstrong (of Schenectady) replies to the recent article of Mr. Kennedy (see Digest, Oct. 20). He states that at the present day the alternator is better understood and can be designed with a greater degree of accuracy than the continuous current machine; the advantage of one type over another in regard to efficiency need not be discussed as one may be made as efficient as the other, but with regard to the life efficiency there is a great divergence; a machine should be constructed to stand all the excessive strain and short circuits involved in commercial work, especially in parallel running now so generally practiced; he divides them into two classes, those with low and those with high armature inductance; a disk armature has little or no inductance, but will have a very strong synchronizing power when running in multiple, but if, from any cause, the field circuit of one machine becomes broken, the current rush through its armature will be enormous and practically destroy it; the regulation of the field current will require very close attention to prevent a large cross current and a dropping out of phase; throwing into synchronism will also require great care. With an armature having a sensible amount of self-induction the rush of current on falling out of step will be limited to perhaps double the normal, which will not be dangerous, and a breaking of the field need not throw it out of step, as the variation between two fields of an ironclad machine running in multiple can be varied within wide limits without interfering with their keeping in step; the best machine is the one having a fair amount of armature inductance; the ironclad construction also gives a good driving support to the armature wire and protects it; another argument in its favor is that there are on the market to-day only one or two types of machines using armatures without iron. He takes exception to some of Mr. Kennedy's statements; cast iron can never be worked to advantage higher than 6 kilogausses, while laminations are worked at double this amount and require only one-fifth the ampere turns to force this flux through the iron, representing a saving of one-half the weight; the cost of the laminations is about 1.4 times that of cast iron, so that the gain is about 25 per cent over cast iron; a well designed ironclad machine will have about 15 per cent leakage, while in the Mordey form the leakage will be much more, for reasons which he gives; the mechanical design of the flat ring type is too fragile for commercial use, the eddy currents in the armature coils and poles are excessive and not well avoidable, while the low self-induction prohibits its use for commercial work with multiple running.

Non-synchronous Motors for High Voltages.—In a short article by Mr. Kolben in the "Elek. Zeit.," Nov. 1, he states that in large transmission installations with high tension, it is preferable in general, to use transformers with the smaller motors, while the larger ones are connected directly to the high tension line, provided the part of the motor containing the high tension currents is not in motion; for large installations synchronous motors were, however, generally used heretofore, partly because the construction of large non-synchronous motors had not been sufficiently developed, and also on account of the large excitation current, but it has now become possible to overcome these objections by careful construction, proper disposition of the windings allowing for only a small leakage, and chiefly by the proper proportioning of the parts; such motors are now made with a high efficiency down to a tenth of their load, they are not sensitive to variations in the voltage and speed of the primary machine, and have the advantage that the continuous current excitation is no longer required; the power factor, that is, the relation between the true and the apparent watt consumption, is not as favorabl ewith non-synchronous as with synchronous motors, but the difference becomes almost nothing at full load. To show the difference between these two styles of motors, he gives curves for an 80-hp synchronous and a 100-hp non-synchronous three-phase motor, both for high tension, built by the Oerlikon Company, the curves giving the power factor, the efficiency and the current for all different loads; the curves show that the power factor of the synchronous motor is more favorable for all loads, but at full load it is only 0.94 as against 0.86; the efficiency of the non-synchronous motor is higher for all loads, the curve being similar to that of a good transformer, the value at full load being 91 per cent. as against 86 per cent. for the synchronous motor.

Alternating Current Motors.—The continued article by Mr. Jacquin on the Lyons Exhibition, in "L'Eclairage Elec.,' Oct. 20, is devoted chiefly to the description of the alternating current motors, including the monophase and biphase motors of Brown.

ARC AND INCANDESCENT LIGHTS.

Lantern Arc Lamp.—The automatic lamp called the "Planet," is described and illustrated in the Lond. "Elec. Rev.," Nov. 2, and is spoken of very highly.

Key Socket and Lamp Holder.—A new form of the one adopted by the Edison Company is illustrated in the Lond. "Elec. Eng.," Nov. 2.

Silvering Bulbs.—A receipt is published in the "Elek. Tech.," Oct. 31.

ELECTRIC RAILWAYS.

Budapest Underground Railway.—The "'Elek. Tech.," Oct. 31, publishes at some length a description of the engineering features of this road which is at present being constructed. It does not run in deep tunnels like the electric underground line in London, but in an underground passage directly below the street pavement, the bottom of the tunnel being no lower than the foundations of the buildings; the length is nearly two miles, the steepest grade is 15.28 per cent. and the sharpest curve has a radius of about 125 feet; the platforms for the stations are ten feet below the streets, requiring only nineteen steps to descend and will have a length of two cars; the inside height of the tunnel is about 8¾ feet, the width 9.2 feet; the roof for the double tunnel is supported in the middle by iron pillars, the width of the double tunnel being about 20 ft.; the bottom of the tunnel is 11¼ feet below the pavement; a special drain pipe will be laid along each of the two sides of the tunnel to drain off the water: on the street on which it is to be laid there are no gas or water pipes in the space to be occupied by the tunnels; the sides of the tunnels are to be made of Portland cement, the bottom of hydraulic cement and the top of cement worked on cross beams resting on the pillars, which are about 13 ft. apart; the work is carried on at two places. The conductor for the current will consist of angle irons supported on insulators on the sides of the tunnel near the bottom, the rails serving as a return circuit; the cars will fill nearly the whole space of the tunnel and will be supported at the two ends on pivoted trucks on which the motors are placed; the inside of car will be 6.8 ft. high, 7 ft. wide and 25 ft. long; it will be divided into three compartments, the two end compartments being reserved for ladies and for those who do not smoke, while the middle compartment is for smokers;—the middle compartment only has sliding doors, one for entering and the other for leaving the car; a car will seat 28 persons and will carry 40; the cars will be lighted with incandescent lamps and the walls will be decorated with mirrors to give the appearance of a large room and to increase the effect of the lights; every car is to have a ventilator, which will operate automatically only when the car is at stations; each car is provided with an apparatus indicating the name of the next station.

South Staffordshire Electric Railway.—A paper by Mr. Dickinson (the inventor of the side trolley system used on that line) is published in part in the Lond. "Elec.," Nov. 2; the most interesting feature to Americans, namely the side trolley arrangement, is omitted in the reprint, it having been described in that journal Nov. 18, 1892. The line is said to have presented many difficulties on account of grades and curves; it replaces a steam line; the trolley wire is suspended at a height of 21 ft. above the road at varying lateral distances from the car not exceeding 13 ft.; a trolley switch is shown and described. From a table giving the data for a number of different English roads, the total cost of running per car mile of this road was 8.12 cents, and the average cost of fuel was .96 cents per car mile; the fear that the amount of wear and tear on the trolley wire would be great was not substantiated, for after fourteen months it was scarcely possible to measure it.

Liverpool Railway.—The article in the Lond. "Elec. Rev.," mentioned in the Digest last week, is concluded in the issue of Nov. 2.

Accumulator Traction.—Acccording to Dr. Stricker, in the "Elek. Zeit.," Nov. 1, a commission of experts is to make a test of the Waddell-Entz copper-zinc accumulator system in Vienna, the tests to begin about the end of November.

Canal Boat Propulsion.—An illustrated description of the Galliot system, described in the Digest Nov. 3, is given in the Lond. "Elec. Eng.," Nov. 2.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Central Station Statistics.—In a recent paper by Dr. Von Stephan, he states that on Oct. 1 there were installed in Germany, exclusive of Bavaria and Wurtemburg, 6,020 installations, of which 5,830 were chiefly for lighting, the number of incandescent lamps being about 1,005,000 and arc lamps 48,715; 64 installations were used for electrolytic purposes and 232 for transmission of power; 353 installations used alternating currents and 19 three-phase currents.

Central Stations in Europe.—A short abstract of the recent summary in "L'Ind. Elec.," mentioned in the Digest last week, is given in the Lond. "Elec. Eng." Nov. 2.

Bolton.—The greater part of the issue of the Lond. "Elec. Eng.," of Nov. 2, is devoted to a long and profusely illustrated description of this station which was recently opened; the illustrations are chiefly of the architectural features of the station; the alternating system is used, the station being apparently at the extreme end of the town; 2,000 volts are generated at the station and are transformed down to 100 volts at transformer sub-stations, feeding into the low pressure distributing mains, where there is a scattered demand house transformers are used.

Calais.—A translation of the description of the plant mentioned in the Digest, Nov. 3, in which alternators were coupled directly with gas engines, is published in the Lond. "Elec. Eng.," Nov. 2.

Agricultural Installation.—A brief description with illustrations of a plant installed on a farm in Austria is given in the "Elek. Zeit.," Nov. 1.

Gas Engines.—An article containing the data of a number of comparative tests of different machines is published in "L'Energie. Elec.," Nov. 1. The same issue contains also a short article from the German on the incrustations in such engines.

WIRES, WIRING, AND CONDUITS.

Electricity in Mining.—Mr. Berthon's article (see Digest last week) is continued in "L'Elec.," Oct. 27; he discusses at some length the wiring and accessories, giving many useful hints and recommendations; the article does not admit of being abstracted briefly; in general, however, he recommends concentric cables, the complete avoidance of all joints, the complete renewal of a cable if broken, the use of a number of leads in parallel so that an injury to one may be repaired more readily, placing the cables in conduits of wood or iron, using no greater lengths than 1,200 to 1,500 ft., the use of fusible plugs only outside of the mines or in cases containing compressed air or oil, at least for mines containing fire damp and the absolute prohibition of the use of an earth return. He describes the Atkinson, Charlton and the Nolet systems of safety cables for mines containing fire damp, the general principle of which is that the breakage of a cable causes an arc to be formed where it cannot ignite the fire damp; the latter form of cable proved itself to be very effective. Cages for the incandescent lamps are described and illustrated.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Railway and Telephone Circuits.—An editorial in the "Elek. Zeit.," Nov. 1, discusses the importance of making tests to prevent railway circuits from interfering with telephone circuits and suggests the introduction into the railway circuit, of a choking coil as required by the British Board of Trade; it seems that this device has not yet been tried in practice.

Induction System.—An editorial in the "Elek. Zeit.," Nov. 1, states that after studying the system suggested by Messrs. Preece and Stevenson, Mr. Rathenau devised a system for communicating across bodies of water by a conduction system but without the use of metallic connection; experiments gave more satisfactory results than were expected; the distance was three miles.

Photographic Recording of Telegraph Signals.—The Lond. "Elec. Rev.," Nov. 2, abstracts a description from a photographic journal of a moderately simple instrument which is inserted in a circuit running parallel to the telegraph wire for a short distance, and which records photographically by means of the action of an electromagnet on a mirror, the telegraphic signals on the line. It is suggested editorially that it could only be used with a single wire line, which for important telegraphs is said not to exist in that country; when a single line is duplexed this system of tapping could not be used.

Railroad Signals.—The Patenall system used in the tunnel of the New York Central Railroad is described and illustrated in the "Elek. Zeit.," Nov. 1.

ELECTRO-CHEMISTRY.

Chemical Theory of Accumulators.—The article by Mr. Wade is concluded in the Lond. "Elec.," Nov. 2. He discusses chiefly the question of the heat evolved in the cell and the difference between the charging and the discharging E. M. F.; the latter should be the same if the accumulator reactions in the one were exactly the reverse of those in the other, but in practice this never happens, as there is always a considerable difference even after allowing for the internal resistance; some curves by Prof. Ayrton are given, from which it appears that for about two-thirds of the charge the E. M. F. is higher than that of the corresponding periods of discharge, by a practically constant amount of about 0.14 volt, but from this point onwards the difference continually increases; he shows that this cannot be ascribed to the rapid accumulation of the liberated sulphuric acid in the electrodes, as the same thing is true in the Groves gas battery; he shows that according to Berthelot, persulphuric acid (containing half as much hydrogen as sulphuric acid) is the primary product at the positive electrode when sulphuric acid is electrolyzed, and he believes that it is this reaction which causes the higher E. M. F., as its formation is accompanied by an absorption of energy and its decomposition by a liberation of energy; as it is an unstable compound it immediately undergoes decomposition, reacting with water and liberating oxygen, part of its energy being restored to the circuit and part being transferred into heat; the difference between the two curves mentioned above is really a measurement of the persulphuric acid formed. Some curves by Ayrton and others are given showing the rise of temperature during the charge and the discharge, and they are discussed at some length. It is believed that there is not much probability or possibility of doing away with the wasteful reaction in the formation of persulphuric acid; some of the heat it is thought is due to imperfect diffusion.

Some Phenomena of Electrolysis and Polarization.—The paper from the Italian by Mr. Martini is abstracted in "L'Eclairage Elec.," Oct. 20; he describes experiments with the electrolysis and with small electromotive forces, of films of liquids extending between two wires.

Testing Baths.—The article by Dr. Kreuger (see Digest, Oct. 27) is continued in the "Elektrochem. Zeit." for November; he describes rapid and simple methods for determining the constituents of a bath by a titrimetric analysis, in which the constituent of a bath is determined by the volume of another solution which must be added to produce certain effects.

Anodes for Electrolysis of Alkaline Cholorides.—In reply to a correspondent to the Lond. "Elec. Rev.," Nov. 2, it gives a brief description of the manufacture of lithanode plates.

The Limits of Electrolysis.—A paper by Dr. Bein is contained in the "Electrochem. Zeit.," for November.

MISCELLANEOUS.

Heating by Combustion and by Electricity.—Some experiments by Mr. Roberts are briefly described in the Lond. "Elec.," Nov. 2; the same wires were heated first in a flame and then by a current, and it was found that with a platinum wire less than 0.5 per cent. of the thermal energy produced in the flame was transferred to the bar, while 90 per cent. of the electrical energy appeared as heat; in another case an iron bar weighing about 20 lbs. was heated by charcoal and then electrically; in the former case about 0.75 per cent. of the thermal energy was transferred to the bar and in the latter 88 per cent.

Electricity as a Motive Power.—In the conclusion of the discussion of Mr. Selby Bigge's paper in the Lond. "Elec. Eng.," Nov. 2, Mr. Thwaite gives the outlines of a proposed plant for an iron and steel works, in which the economy of coal was essential and in which the coal was to be converted into gas, which was stored and utilized for furnace work and for the generation of electric energy for driving the machinery.

Thermostat.—A new and simple form which is very highly spoken of, made by Naglo, is described and illustrated in the "Elek. Zeit.," Nov. 1. It is based on the difference between the two gases separated by a membrane, the membrane closing a circuit; it is said to be very sensitive and entirely independent of the pressure of the atmosphere; a mere touch of the hand is sufficient to start it with; it is said to be the most reliable and simplest of all those that have been introduced.

Registering Device.—A recently patented device is illustrated and described in the "Elek. Anz.," Nov. 1, used chiefly for controlling the time when workmen arrive; it operates type by electrical contrivances, the impression from them being taken by hand.

Fatal Charges from Single Leads.—A peculiar case is recorded in "L'Eclairage Elec.," Oct. 20, in which an electrician, Mr. Smillie, noticed that small birds perched on a single wire carrying 20 amperes for charging accumulators, were instantly killed the moment the circuit was closed; this shows that the killing of birds by electric wires is not necessarily due to their flying against them, as is often supposed.

Platinum and Its Metals.—A paper on the platinum exhibit at the Antwerp Exhibition, by Mr. Andreoli, is published in "L'Eclairage Elec.," Oct. 20.

Educational.—A brief synopsis of the course at the Central Laboratory in Paris is given in the Lond. "Elec. Rev.," Nov. 2.

Review of Recent Developments.—In an address by Dr. Van Stephen, published in the Elec. Zeit.," Nov. 1, he gives a brief review of the recent development of the application of electricity.

Paris Exhibition of 1900.—The classification of the group "Electricity', is given in "L'Eclairage Elec.," Oct. 20.

Prizes.—A list of prizes offered by a French society, is published in the Lond. "Elec. Rev.," Oct. 26.

New Books.

THE ELECTRIC CENTRAL STATIONS AT COLOGNE AND AMSTERDAM. By Carl Coerper. Translated from the German by Clarence P. Feldman, New York: The W. J. Johnston Company, Ltd. 32 15"x22" pages of text, 60 illustrations and 33 double page engravings on card board. Price, $25.00.

This magnificent volume, in typography, press work, paper, illustrations and binding, stands unrivalled among engineering publications, and is truly a masterpiece of the art of book-making. With its beautiful head and tail pieces, colored page borders, highly calendered paper, press work, its engravings printed on heavy cardboard and handsome binding, the execution of the book is that of an art publication, and yet there is no sacrifice of the real object of the work as an engineering treatise. The two great central stations which it describes are worthy of the setting given them, for they are acknowledged to be not only the finest on the Continent, but examples of the highest engineering art.

Though the text is limited to 32 pages, when we consider that each of these pages is almost four times the size of that of The Electrical World, it will be understood that they contain by no means an inconsiderable amount of matter. The wood-cuts included in the text are in keeping with the plan of the work in their execution, and enable the details to which they refer to be clearly understood.

The first section of the text is devoted to the Cologne station, and opens with a description, with references to the plates, of the steam plant. The alternators are then taken up and their construction explained and illustrated. The controllers are next considered in considerable detail. This apparatus, from its appearance, is more suggestive of a marine engine room than of a central station, both in the substantial and thoroughly mechanical design displayed and in the use of levers and wheels entirely for operating the parts. The switches, rheostats, etc., are in a room which is locked during the operation of the machinery, and the various devices are manipulated by means of connections to the levers or wheels of the controllers, which are on a platform by a column to which is secured the various meters. By this means there is absolute security from contact with dangerous wires or fittings, as the dynamo connections are carried in closed conduits to the switch room, and there is no electrical connection whatever between the controller levers and their corresponding devices in the switch room. The controller levers also have interlocking devices which prevent them from being moved in any other than the proper sequence.

Each controller has four levers; one, with four positions, successively places the alternator out of circuit, connects it to the load resistance, where it is locked until the necessary resistance is put in, then connects with another alternator in parallel or to the network, and, finally, at the last notch takes out the load resistance. Another lever, for the fields, has three positions; in one position it disconnects the compound exciter and connects a single exciter; the second movement brings up the exciting E. M. F. to 65 volts, and the third couples the compound exciter in parallel to one or all of the working exciters in such a way that the series winding of one exciter carries the armature current of the other, while their terminals send the currents into two collecting rings, this method being one of the features of the Helios system. The two remaining levers are for the regulation of the exciting current. The method of connecting in parallel is explained with reference to a double page engraving, showing the various connections. The final part of this section is devoted to the station wiring arrangements and to the distributing network, and contains illustrations of cut-out stations, connecting boxes, underground house connections, etc.

In the section devoted to the Amsterdam station the steam plant is discussed more in detail. Throughout this section only those parts of the electrical and other equipment are described in detail that are omitted from the Cologne station section or are different in character in some notable detail. The cables are illustrated in full size section in colors, and colored cuts show the manner of insulation and the method of laying the cables underground, which consists of suspending the cable centrally in a wooden trough and then filling in with molten asphalt. Several interesting curves of output are given, one showing the output in one day in the middle of each month from June to December, another from January to June and a third giving the highest load and the receipts and house installations from June, 1892, to December, 1893.

The next section takes up the transformers, meters, motors and other devices. Several instructive curves showing the performance of the transformers are given, and considerable space is devoted to candle-power curves of alternating arc lamps. One of the accompanying tables shows that with a 310 watt, 10 ampere current which, without a reflector, gives a mean spherical candle- power of 550, the light is only reduced to 498 candle-power when a reflector is used. With the reflector, however, all light is thrown below a horizonal plane through the arc. The section concludes with a description of the Coerper induction motor, which is well illustrated, the system of winding being also schematically shown, and a full page plan, in colors, of the primary and secondary works of distribution in Amsterdam.

The two final sections are of particular value, as they give costs, the results of working, and general financial data. A table shows the relation between the number of watts annually spent in magnetizing and the useful output, and other tables give the distribution of light, cost of operation, etc.

The plates, which are all double page cardboard, are beautifully printed, the half-tone process used giving results much superior, as far as we know, to any employed in this country. On maps of Cologne and Amsterdam the distributing net-works are indicated. There are a number of interior and exterior phototype views of the stations and of the machinery, the process used bringing out the details of the latter remarkably clearly. Other plates give plans and elevations of the boiler rooms, engine rooms, etc., a diagram of connections for parallel working, line drawings of machinery, etc.

To the engineer this work will prove of great value, as the plans given are working drawings, while the station manager will find much to interest him in the full details of these fine stations, every minute part of whose design having been the subject of the closest study by throughly trained and competent engineers, and with a view always to the highest economy in working.

ELECTRIC TRANSMISSION OF ENERGY. By Gisbert Kapp. Fourth Edition, New York: D. Van Nostrand Co., 445 pages, 166 illustrations. Price, $3.50.

The fourth edition of Kapp comes like a visit from an old friend. The first edition appeared at the time when there was no art of electrical power transmission and it speaks well for the foresight of the author that so much of his early work can remain to-day comparatively unchanged. The first six chapters dealing with the general principles of dynamos and motors have been but little altered, the most important modifications being in the addition of recent data to the magnetic design of dynamos. The latter half of the book is completely re-written. One of the great difficulties in producing a book upon applied electricity to-day is the choice of an audience. Those who are interested in electrical work differ so widely in attainments, needs, and point of view that in a single treatise it is well nigh impossible to satisfy them all. Mr. Kapp in his present volume appeals directly to the student class and the treatment of the subject is distinctly scholastic. By this I do not wish to be understood as saying that the book is lacking in value to the practical engineer or the investigator, but merely that the treatment is such as to be of the greatest service to the student. In so directing the trend of his work, the author has adopted methods which, while generally popular and often employed, are less general and sometimes more complex than is to be desired. One of the most difficult tasks for a writer on scientific subjects is to strike a happy medium between a direct mathematical discussion of a subject and one based almost entirely on physical considerations. There is even now no satisfactory treatise which stands as a half-way station between the beautifully clear and acute reasoning of Faraday and the splendid mathematical discussion of Maxwell. The course adopted in the present work is perhaps as near middle the way as could well be, but it is necessarily a little too complicated for the general public and less searching than is desired by many students. This fault is, however, perhaps unavoidable. The most important additions to the first editions of the work are the chapters on transmission by alternating currents. Especially to be commended is the chapter on single phase motors, which is the first tolerably simple explanation of the subject which has yet appeared in print. It is necessarily approximate, but opens up to the student a very interesting view of the matter. Here and there it is a trifle misleading, as for example in the stress laid on the necessity for self-induction in such motors. As a matter of fact, the difficulty in building practical single phase motors is to reduce the self-induction sufficiently, and not to maintain it. The necessities of design take care of all possible needs in this particular line. It is rather a pity that the same point of view taken for the single phase motor was not adopted for the discussion of the polyphase systems. The general principles that underlie the action of these two classes of motors are far more similar than is generally supposed. The discussion of polyphase apparatus is, however, on the whole satisfactory. Perhaps a little too much stress is laid on constant current working in polyphase circuits for the method is one that probably will be very little used. The author is particularly happy in pointing out the practical differences and the theoretical similarity between the two-phase and the three-phase systems and the advantages of polyphase motors. It is a little singular, however, that he does not lay more stress on the matter of windings. Most of his results are those obtained from motors with armatures of the squirrel-cage type which are decidedly inferior to and but little simpler than, the short-circuited windings used in American practice, about which Mr. Kapp seems not to have fully informed himself, although his book is well up to date in most other respects. In speaking of the alternator proper, it is interesting to note that the author strongly favors moderate frequencies, from 40 to 65 cycles per second being his choice. His reasoning about the effect of frequency upon the cost of machines is somewhat at fault, however, as he does not point out clearly the fact that with high frequency machines, the unfavorable proportions which often have to be given the field magnets, are a serious disadvanatge. As a matter of fact, it is quite as easy, or easier, to build a low frequency machine for close regulation as a high frequency machine of the same capacity. One must take rather sharp exception to Mr. Kapp's advocacy of considerable self-induction for the armatures of alternators. To be sure, self-induction does act as a safe-guard in case of short circuits, but it is a safeguard which is too expensive and undesirable on account of its effect on the regulation. Some important matters are sadly neglected. It would have been desirable to have given a clear account of the methods used in converting alternating currents, single and polyphase, into continuous currents, as

these are likely to play no small part in the future of the arc, even if the apparatus employed should never be simpler than the rotary converters used in this country. In spite of these faults and omissions, which are perhaps unavoidable in the construction of any handbook of a widely ramifying subject, the present edition of Kapp is by far the best work on the subject which has yet appeared and deserves a place on the table of the student and engineer, to whom it cannot fail to be useful. It is specially valuable as bringing together in connected form a treatment of those modern aspects of power transmission which have been, until now, only treated in the technical journals and even there in such diverse ways as to befog rather than explain the important subjects considered.

QUANTITATIVE CHEMICAL ANALYSIS. By Dr. Alexander Classon. Translated and enlarged by Wm. Hale Herrick. New York: John Wiley & Sons, 220 pages, 56 illustrations. Price, $2.50.

This book is probably the most complete work which has has yet appeared treating upon the subject of quantitative analysis by electrolytic methods. The present addition contains a very considerable quantity of new matter added by the author, and this, with the additions by the translator, brings the book thoroughly up to date. Part I deals, first, with the different means of obtaining and regulating the current; the size and shape of the electrodes, etc. In the section on thermopiles, the translator has given a description of what would appear, from a mechanical and electrical point of view, the best thermopile yet constructed, the invention of a Dr. Paget. It is stated that it is used at the Chicago Refining Works with complete success. Among the batteries described we miss the Edison-Lalande-Chaperon. This, in the writer's experience, is preferable to either the Daniell or storage battery, for the reason that to obtain good results, the voltage on the electrodes must not vary when the apparatus is left to itself overnight with a determination under way, and this desired constancy of voltage is obtained most perfectly with the Lalande cells. The remainder of Part 1 is taken up with a description of the methods of determining all the principal metals that can be deposited from aqueous solutions, and of the methods of separating one metal from others with which it may be associated. Full details are given as to the best size of electrodes, best current density, and concentration of solutions, data which are only too frequently omitted on accounts of electrolytic methods. Unfortunately, the current is often given in cubic centimetres of detonating gas per minute. This method of measurement should be abandoned, as it is apt to lead to errors, and moreover, necessitates an extra volt for the decomposition. The chapters on the determination of the constitutents of alloys and on the analysis of ores are very complete, and there is a very good appendix containing tables, list of reagents, etc. A considerable number of the processes would be very much shortened, however, if a volt meter were used and the solution first electrolysed at one voltage till all of one constituent was removed, and then the voltage raised until another constituent was removed, and so on. In this method, almost any acid may be used as the solvent and with an automatic voltage regulator and an accurate volt meter and ammeter, a great many different metals can be plated from the one solution, each metal coming over at one definite voltage. There is a wide field here for research, and the investigations of a chemist who attacked the subject of electrolytic separation, armed with these instruments, could hardly fail to result in important developments.

Amongst other things in Part 2, Professor Smith's electrical method of decomposing refractory ores will be welcomed by those who have much work of this kind. On the whole, the book will be found invaluable by all chemists who prefer electrical to purely chemical methods of analysis.

Relative Importance of Electricity in Physics.

In the last number of the well known physical journal, the *Philosophical Magazine*, six of the seven articles are on electricity, and of these three were contributed from America.

A Western Water Power Plant.

Eighty-eight miles from Chicago on the line of the Michigan Central R. R. at the City of Buchanan, Michigan, is one of the finest water powers in the Western States. The Buchanan Power and Electric Company have, during the past two years, acquired the water rights and necessary land to build a dam across the St. Joseph River, which is able to furnish the company with some 3,000 minimum horse power at low water. During the Summer months the average flow is twelve inches over a dam 400 feet in length.

A power-house has been built on the north side of the river, an interior view of which is shown herewith, where, at the present time, a very finely equipped plant for electric lighting and power is now in daily operation furnishing arc lighting for the streets and stores, alternating current for residences and commercial lighting, and a power circuit for driving the pumps at the city water-works and furnishing current for motors in factories and small shops. The power at present is derived from three turbines of vertical type geared to a line shaft extending from the wheel pits through the entire length of the main dynamo room. The arrangement is such that either or all of the wheels may be used at the same time on the main shaft. Within the dynamo room the shaft is provided with driving pulleys on quills, which are governed by friction clutches.

The present electrical equipment was furnished by the Standard Electric Company of Chicago, and consists of one 60 light Standard arc dynamo, which furnishes current for the street lamps and commercial arc lights; a 4-5kw., 550 volt multipolar power generator, which furnished current for the power circuit to which is attached motors for driving the pumps in the city water-works, as well as various small motors scattered about the towns, also a Standard 1,250 light alternator, 1,100 volts primary, and a full equipment of arc lamps, converters, etc.

Buchanan (Mich.) Power House.

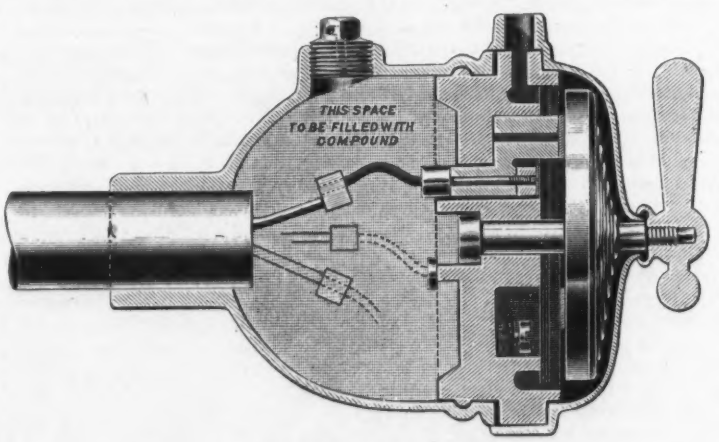
The switchboard is finely equipped with Standard instruments and accessories.

On the opposite side of the river the company is now putting in additional wheels for about 800 horse power capacity, which will be used in the development of power for factory purposes. Some two or three large factories have already been secured which will employ altogether some 200 or 300 hands. Arrangments are being concluded for the location at Buchanan of a number of smaller factories, which will be built at most advantageous points for shipping and use electric motors for power.

A New Service End and Cut-out.

We illustrate a new service end cut-out made by the Interior Conduit and Insulation Company, 44 Broad street, New York, designed to be placed at the inlet of the three-wire system to buildings, and control all the circuits for light and power, the cut-out in case of fire being accessible to firemen. The advantage claimed over a triple break down switch is that it is thoroughly waterproof, an important point since the switch is almost always placed in a location where there is more or less dampness. The piece of pipe enclosing the three conductors is embedded in insulating material and is a standard article of manufacture, as are also the flexible conductors used within the iron case.

In installing, the flexible conductors are first attached to the terminals



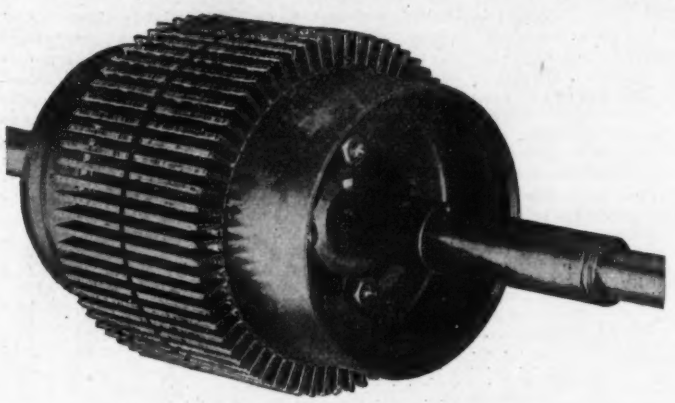
Service End Cut-out.

projecting from the conduit; the porcelain base is taken out of the cast iron case, the switch spring disc removed and the wires connected up, using proper fuses, the conduit terminals being carefully soldered to the flexible connector. The porcelain base then is packed with any convenient material, such as sisal rope, the two halves of the iron case put together with their flange bolts, the plug removed at the top of the case and the cavity filled in with insulating compound. The risers are con-

nected through the three inlets provided for that purpose and the mouths packed as they pass through the iron case to insure a tight joint. The cut-out was devised by Mr. E. H. Johnson, president of the Interior Conduit and Insulation Company, in conjunction with Mr. J. H. Van Vleck, electrical engineer of the New York Edison Illuminating Company.

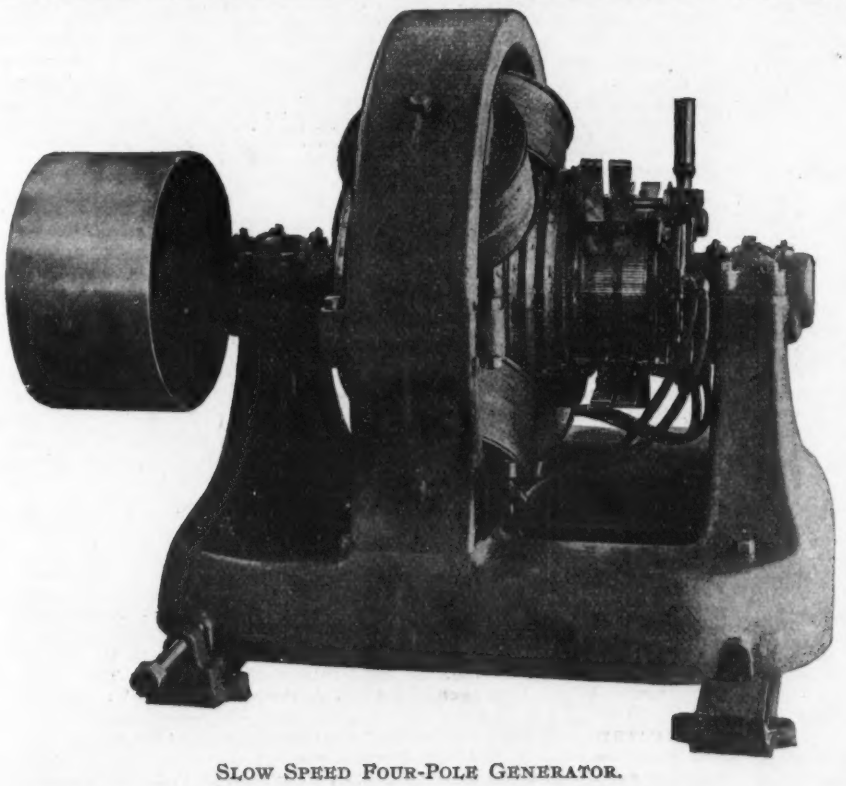
Slow Speed Multipolar Machines.

The General Electric Company has within the past month brought out a new series of slow speed four pole generators and motors which have given excellent results, both under shop test and in commercial operation. The generators, which are built in sizes up to 60-kw, have the magnet circuits shortened, and a greater output and a higher efficiency are obtained from a given weight and speed than from the bipolar type of



ARMATURE OF SLOW SPEED GENERATOR.

generators. The saving of floor space effected by the shape, and slow speed render this type of machine particularly valuable. It is well known that the high speeds common to the bipolar type of machine have



SLOW SPEED FOUR-POLE GENERATOR.

given rise to serious loss of energy in the belts, to expense in maintenance, to noise from belts, to trouble with bearings, to mechanical injury to the armatures and to other objectionable features with which users of this type of machine are familiar. From the slow speed generators under consideration the faults just enumerated are for the most part eliminated. With cheapness in price they combine simplicity in construction, easy accessibility for inspection and repair, and require even under extremely severe usage the minimum of attention.

The frame and pole pieces are of cast soft steel of highest magnetic permeability. The armatures are so constructed as to expose the core and windings to constant currents of air, and the copper wire coils are formed and thoroughly insulated before being placed on the core. The insulation is of mica and tough paper and possesses the highest spark resisting qualities as well as great mechanical strength and durability. The design is such that at full load and continuous run the temperature is only slightly elevated. The commutator and brushes work perfectly under all conditions of load and the brush holders give a parallel motion which insures perfect contact with the commutator at all times. The pillow blocks are cast in one piece with the bed plate, and thus it is impossible for the self-aligning and self-oiling bearings to get out of line and the armature off centre. The armature spider is extended and the windings are bound down solid upon it. This gives additional radiating surface and overcomes the difficulty entailed by loose binding wires, while the shape of the spider and the coil allows the ready replacement of an injured coil when necessary. The commutator is pressed upon the shaft and then keyed and the winding section and commutator bars are directly connected. The brush holders are all mounted on a rocker arm and may be shifted simultaneously upon the commutator face. They are so constructed that the brushes will always be presented to the commutator surface at the same angle.

The slow speed motors are similar in appearance to the generators, and by changing the field spools the motor can be changed to a generator for lighting or power purposes and vice versa. All parts are interchangeable. The motors are absolutely sparkless and changes in load from overload to no load may be made without varying the position of the brushes.

In addition to the above generators and motors, the General Electric Company has designed a line of moderate speed motors and generators to run at a slightly higher speed. They differ from the slow speed type only in the fact that the armature and pulleys and in some cases the field windings are special.

Electrical Mail Box.

We illustrate herewith an electrical mail box invented and patented by J. W. Coe, Jr., of Chicago. It consists of the ordinary mail box, on the top of which is a device by means of which a signal is sent to the occupant of the building when a letter has been placed in the box. The act of opening the box to insert the letter starts a very simple clock motion and the circuit is closed, or rather the commutator turns with the closing of the box. The commutator revolves continuously in one direction so that there is nothing to get out of order. It is understood that the post office authorities favor the device, as it automatically insures the signalling for the delivery of mail and enables the people to

ELECTRIC MAIL-BOX.

LAMP SUPPORT.

distinguish its ring—three short ones—from the ordinary call. It can be placed in the same circuit with the call bell.

Incandescent Lamp Support.

A simple and reliable device for adjusting the height of incandescent lamps, manufactured by E. A. Gay & Company, Beckley Building, 27 South Clinton street, Rochester, N. Y., is shown in the accompanying illustration. The entire device is made of the best insulating material. The balance being a shot-weighted soft rubber ball, it will not break lamps or shades accidentally brought into contact with it. The form of attachment to the lamp cord is such that any size of cord will be securely and positively held without danger of slipping or becoming loose. As the ball is weighted with shot it can easily be adjusted to balance additions to the weight of the lamp. It can be instantly applied or removed without changing the cord or connections in any way.

Financial Intelligence.

The Electrical Stock Market

New York, Nov. 17, 1894.

GENERAL ELECTRIC has been very steady in its quotation. The bull party in the stock is still confident that much higher prices are close at hand, basing their hopes on the continued reports regarding the business the General Electric Company is now doing. So great is the pressure of orders—this is given out as coming from official sources—that the force at Lynn will shortly have to be increased. It is a mistake to suppose, because the pay roll at Schenectady is now double what it is at Lynn, that work had anywhere near ceased in the shops at the latter place. A director offers this piece of information: "Regarding the large order placed with us by Mr. Yerkes, of Chicago, amounting to $500,000, all the indications point to a large increase in this order. Just the extent of this increase it is difficult to estimate; I doubt if Mr. Yerkes can tell what the ultimate amount will be. The outlook for General Electric is excellent. Of course prices are lower than they were a year ago, but business is very good. What worries us now is how to fill orders already on our books." This bears out the reports of prosperity current for some time. The indications for a great growth of electric railroad construction next spring offer a lot of promise. Capital has been endeavored to be made out of some litigation announced this week as effecting General Electric one way or the other. Mr. Fish, counsel for the company, says that the decision restraining Bloomingdale Brothers, New York, from using incandescent lamps with carbon filament vacuum is a great victory for General Electric. Regarding the storage batteries litigation, Mr. Fish says: "I am confident the court will sustain the suit of the Brush Company against the chloride battery people (the Elec-Storage Battery Company, of Philadelphia). The testimony has not yet been taken, however, and decision will probably not be rendered for a year or more."

WESTINGHOUSE ELECTRIC issues are a little more active. The story now is that the next dividend on Westinghouse Electric preffered stock will be paid in scrip instead of cash. This is as yet only gossip, but it may have a foundation in fact, as the company has been spending a lot of money on the new plant. A very considerable portion of the Westinghouse Electric Company's plant has already been removed to the new buildings at Brinton, Pa., and the work of changing is progressing at a rate that will make the entire removal complete by January next. The business of the company continues good. For October it aggregated about $500,000, most of it in small contracts. Earnings continue large, and all shops are running to their full capacity on orders taken on a basis equivalent to cash, and secured in sharpest competition with the field. Low prices for electrical equipment continue to rule, but the company, nevertheless, is understood to be making a satisfactory profit. As one of the Westinghouse Company's friends puts it. "Few, if any, manufacturing concerns of equal magnitude could make a better showing on business done and business in sight than the Westinghouse Electric and Manufacturing Company."

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	101	102
" " " Brooklyn	100	109	112
" " " Boston	100	125	128
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Construction & Supply Co., com.	15	7⅛	10
" " " " pref.	15	7⅛	10
Fort Wayne Electric	100	2	3
General Electric	100	35	35⅛
General Electric, pref	100	67	70
Westinghouse Consolidated, com.	50	35	36
" " pref	50	52	53

BONDS.

Edison Electric Ill., New York	1,000	107¼	107⅜
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	90	91

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	195	197
American District Telegraph	100	40	45
American Telegraph & Cable	100	88	91
Central & South American Telegraph	100	102	105
Commercial Cables	100	125	145
Erie Telephone	100	52	54
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
*New England Telephone	100	67	69
Postal Telegraph-Cable	100	50	55
Western Union Telegraph	100	88	88⅛

*Ex-div.

AMERICAN BELL TELEPHONE stockholders have voted to authorize the president to request the Commissioner of Corporations of Massachusetts to take action under the act of the Legislature and fix the market price for an offer of 5,000 shares of additional capital stock to the shareholders. This issue is in the nature of an experiment, and upon its outcome depends the increase of the capital stock from the present $20,000,000 to the $50,000,000 authorized by the Legislature under certain restrictions. The $30,000,000 new stock is required for extensions of long distance lines to the West, Northwest and South, and in developing sub-company exchanges, etc. Pending the result of the "experiment," very little trading is being done in the stock.

ELECTRIC STORAGE BATTERY stock slumped this week 9½ points to 20, on the adverse result of litigation in New York, but it recovered somewhat afterward on the statement by President Robert W. Gibbs that the decision is not final and only delays work until May next, when the patent on which the suit has been brought expires. "The result of the decision," says Mr. Gibbs, "does not affect the value of the company to any extent, and will not in any respect interfere with its operations."

EDISON ELECTRIC ILLUMINATING, of New York, according to figures furnished by Treasurer Williams, continues to forge ahead. Gross earnings in October were $122,723, a gain of $18,275 over October, 1893, while net earnings show a gain of $4,273, the total being $60,527. For the ten months ending October 31, gross earnings were $1,090,112, an increase of $133,444 over a similar period in 1893, and net earnings were $563,491, a gain of $122,367.

EDISON ILLUMINATING, OF BROOKLYN makes equally as good a showing. Gross earnings for October were $42,239, a gain of $12,239, and net earnings were $20,453, a gain of $5,654. Net income was $21,767, an increase of $5,518. Interest on bonds calls for $2,100, so that there is left applicable for dividends $19,667, an increase of $5,518. or over 40 per cent.

WESTERN UNION TELEGRAPH has fluctuated somewhat, but not much. The bull pool seems to be reducing its holdings to a moderate extent, and manipulators have generally been sellers of the stock.

THE STREET RAILWAY & ILLUMINATING PROPERTIES have further set aside $60,000 to buy in preferred stock; bids will be received till November 21.

THE NEW YORK & NEW JERSEY TELEPHONE COMPANY, the Bell Company's rival on Long Island, has just had $910,000 of its general mortgage 5 per cent. bonds listed on the Stock Exchange.

ELECTRIC TRACTION STOCKS, a class of securities that lately have found a deal of favor, especially among investors, by reason of the great possibilities of increasing earnings and the assurance of security attaching to the companies they represent, are day by day attracting a larger share of Wall street's attention. But one or two are actually listed on the Stock Exchange, but a goodly lot of transactions occur on the outside. In Philadelphia, Baltimore, Chicago and Boston, however, an ever-increasing business is being done in these securities on the local exchanges, Philadelphia trading being often times given over entirely to traction stocks. The local market has been rather quiet this week, but the following table gives some indication as to what is being done in the stocks traded in in New York:

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	140	150
Brooklyn Traction pfd.	65	68
" " common	13⅛	15
Long Island Traction	12⅛	13
Rochester St. Ry	29½	30⅛
Columbus St. Ry	45	50
Louisville St. Ry. pfd	87	88
" " " common	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	56	58
North Shore Traction	22½	—
New Orleans Traction	59½	—
Worcester Traction pfd	82	86
" " common	14½	16
Metropolitan Traction Philadelphia	108	109
Philadelphia Traction	104	104½
People's Traction	54	54½

BONDS.

	Bid	Asked
*Union Ry. 1st. mtge 6s	105	108
*Westchester Electric 1st. m. 5s	98	101
Rochester St. Ry. 1st. 5s	95	97
*Columbus St. Ry. 1st 5s	89	92
Columbus Crosstown 1st. 5s	—	90

*With accrued interest.

New Incorporations.

THE PEOPLES' ELECTRIC LIGHT COMPANY, Valparaiso, Ind., capital stock $30,000, has been formed.

THE TURNBULL ELECTRIC LAMP COMPANY, New Orleans, La., capital stock $300,000, has been formed.

THE PHOENIX NATIONAL TELEPHONE COMPANY, Indianapolis, Ind., capital stock $100,000, has been incorporated by Marlin Caldwell, John W. Parrish and Jacob Frankel.

THE MUNCIE ELECTRICAL WORKS, Muncie, Ind., capital stock $25,000, has been organized to manufacture and sell electrical and other machinery. Webster S. Richey, Albert S. Richey and Richard F. Platt are interested.

THE JASPER COUNTY ELECTRIC RAILROAD COMPANY, Carthage, Mo., capital stock $150,000, has been formed to construct a railroad. The promoters are J. W. Halliburton, F. W. Fitch and Isaac Perkins, all of Carthage, Mo.

THE MT. JEWETT ELECTRIC LIGHT AND POWER COMPANY, Mt. Jewett, Pa., capital stock $2,000, has been incorporated to supply light, heat and power. M. J. Gallup, A. G. Phillips and C. J. Stahl, all of Mt. Jewett, are interested.

THE EQUIPMENT CONSTRUCTION COMPANY, Albany, N. Y., capital stock $10,000, has been incorporated by Montgomery R. Johnson, Thomas P. Nightingale, Utica; Lena Beecher, Chas. A. Seaver and Jos. W. Holmes, Batavia, N. Y.

THE CAMBRIDGE ELECTRIC LIGHT AND POWER COMPANY, Cambridge, Ill., capital stock $12,000, has been formed to erect an electric light plant. The organizers are D. D. Lamb, Henry White, C. M. Turner, H. D. Richardson and F. O. Dahlberg.

THE BELVIDERE TELEPHONE COMPANY, Belvidere, Ill., capital stock $6,000, has been formed to furnish telephone and electric service and electrical supplies. W. M. Mareau, Omar H. Wright, Jr., John G. Tripp and J. R. Balliet, are interested.

THE PERU ELECTRIC LIGHT AND POWER COMPANY, Peru, Ind., capital stock $60,000, has been formed. Volney Q. Irwin, Crawsfordville, Ind.; Paul E. Covington, Kansas City, Mo., and Nat. Covington, Peru, Ind., are among the incorporators.

THE MADISON ELECTRIC LIGHT & POWER COMPANY, Madison, Neb., capital stock $10,000, has been formed to construct and operate an electric light and power plant in Madison. The promoters are Wm. V. Allen, Peter Rubendall and Frank P. Prince.

THE ATLANTIC & PACIFIC IMPROVEMENT COMPANY, Tacoma, Wash., capital stock $400 000, has been formed to buy and sell personal property and real estate, build and operate electric railways, etc. Charles B. Mortice and John R. Mortice are the promoters.

THE FLORENCE POWER AND WATER COMPANY, Florence, Col., capital stock $100,000, has been organized to supply electric and steam power for mills, also a system of water works, etc. W. E. Johnson, W. K. Johnson and H. A. Sumner, all of Florence, are interested.

THE BOSTON & SEQUIM COAL COMPANY, Port Townsend, Wash., capital stock $50,000, has been formed to operate electric plants, railroads, mines, etc. Wm. B. Dennis, Wm. A. Halteman, N. C. Strong, H. H. Boyce, D. C. Heath, A. B. Poland and Graham D. Dennis are interested.

THE ELECTRICAL MAINTENANCE COMPANY, New York, maximum capital stock $250,000, has been formed to contract with owners of dynamos, electrical plants, etc., to keep same in good repair, etc. John Dau, Freman D. Bewley, and R. L. Johnson, New York City, are interested parties

THE MECHANICSVILLE AND BOILING SPRINGS ELECTRIC RAILWAY COMPANY, Harrisburg, Pa., capital stock $100,000, has been incorporated to construct, maintain and operate an electric railway. John B. Skyles, Martinsburg, S. Ritter Ickes and W. K. Meyers, Harrisburg, Pa., are the promoters.

THE F. P. ELECTRIC COMPANY, Chicago, Ill., capital stock $500,000, has been incorporated by Edward J. Frost, Charles W. McCorkle and E. W. Cramer.

THE MICHIGAN LIGHTING COMPANY, West Bay City, Mich., capital stock $10,000, has been incorporated by Frank Mohr, George Standacher and Edward McGinnis.

THE NORRISTOWN AND PERKIOMEN CREEK ELECTRIC RAILWAY COMPANY, Philadelphia, Pa., capital stock $50,000, has been formed to conduct, maintain and operate an electric railway. P. W. Smith, Drexel Building, Philadelphia: Harvey R. Parsons and James J. Rehan, of Philadelphia, are the promoters.

THE BOYNTON TRANSIT COMPANY OF SPAIN, New York, maximum capital stock $5,000,000, has been formed to acquire patents for appliances relating to steam and electrical railways, etc. J. F. De Navarro, New York; Eben Moody Boynton, Newbury, Mass., and Wm. H. Boynton, New York, are intrested parties.

THE CENTURY TELEPHONE COMPANY, New York, maximum capital stock $250,000, has been formed to manufacture and use all kinds of electrical machines, etc. construct, equip and operate telegraph and teleph ne lines, etc. Henry O. Reed, E. F. Birdsall, New York, and G. H. L. Morton, Dobbs Ferry, N. J., are the promoters.

THE MOUNT VERNON AND WALHONDING ELECTRIC RAILWAY COMPANY, Mount Vernon, O., capital stock 50,000, has been formed to build and operate an electric railway, or to operate by other motive power between Mt. Vernon and Walhonding. Fred. T. Botzum, W. F. Bullinger, Harry C. Devin, and others are interested.

THE BOYNTON TRANSIT COMPANY OF FRANCE, New York, maximum capital stock $5,000,000, has been incorporated to acquire patents and patent rights for appliances, etc., relating to electric and steam railways, etc., in France. The organizers are J. F. DeNavarro, New York; Eben Moody, Newbury, Mass., and Wm. H. Boynton, New York.

THE KIDDER ELEVATOR INTERLOCK COMPANY, New York, maximum capital stock $300,000, has been formed to manufacture and sell electrical, mechanical, pneumatic appliances, etc., for use on passenger, freight and other elevators. W. P. Kidder, Boston, Mass.; Clement B. Smith, Wilmington, Del., and H. S. Stallknecht, New York, are the organizers.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Nov. 17, 1894.

THE COMMITTEE ON GAS AND ELECTRICITY of the Brooklyn Board of Aldermen reported in favor of granting a franchise to the Municipal Electric Light Company for the part of the city not covered by its existing grant.

COMMISSIONER WHITE, of Brooklyn, has been asked for authority to prepare specifications and advertise for proposals for gas and electric lighting of the streets and public buildings during 1895. The existing contracts expire December 31st.

THE ELECTRIC HEAT ALARM COMPANY, West First street, South Boston, has opened an office in New York at 1139 Broadway, Room 5, with Mr. Chas. Lyman, formerly in charge of Mills building, as manager. Among other apparatus are some excellent devices for marine work which are well worth inspecting.

THE ALDERMANIC COMMITTEE ON GAS & ELECTRICITY of Brooklyn, N. Y., will report in favor of granting a franchise to the Municipal Electric Light Company to extend its plant, now confined to the Eastern District, into the Western District wards. The company is to pay the city $20,000 in cash for the privilege, furnish arc lights to the city for 40 cents apiece per night and put all wires underground.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, November 17, 1894.

MR. F. E. PETTINGELL is no longer identified with the Thompson-Brown Electric Company, of Boston, having tendered his resignation and the same has been accepted.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has removed its New England office from 620 Atlantic avenue to Exchange Building, 53 State street, Boston, where it is located on the third floor, its quarters embracing five commodious rooms.

CAPT. WILLIAM McGREGOR, formerly collector and treasurer of the Pawtucket (R. I.) Gas & Electric Light Company, and connected for 10 years with the company, has by a unanimous vote of the Board of Directors been appointed superintendent of the entire business of the company, to succeed the late Mr. Samuel G. Stiness—a recognition well deserved by a faithful discharge of duty.

MR. ALTON D. ADAMS, electrical engineer, 620 Atlantic avenue, Boston, Mass., has undertaken the repair of electrical machinery with facilities second to none in the country, for the heaviest class of work. The equipment is all on the ground floor, and machines are unloaded from cars by cranes directly into the shop. A specialty will be made of heavy central station repairs and the largest machines now in use can be readily handled. Mr. Adams' experience and success in the design of electrical machinery indicate that work intrusted to him will be carried out in the best manner.

THE COLBURN ELECTRIC MANUFACTURING COMPANY, of Fitchburg, Mass., has decided to locate in a home of its own, and with that end in view will at once commence the construction of a handsome two-story building of 40 feet frontage and 155 feet depth, the arrangements and appointments of which will embrace all possible facilities and accommodations for the manufacture of its dynamos, motors and other electrical apparatus which are so well known as to require no special mention. The new building will be on Winter street, right near the depot and very near the spot on Boutelle street where Mr. Colburn started in the electrical business in 1881.

MR. R. O. Hood, for the past three years connected with the General Electric and T.-H. Companies as meter expert and in charge of the New England meter business, has severed his connection with the company and opened an office at 15 Federal street, Boston, where he will represent the Wagner Electric Manufacturing Company and Columbia Incandescent Lamp Company, of St. Louis, Mo. The Wagner Company, as is well known, are making a specialty of high grade transformers of high efficiency and remarkably small leakage current. Mr. Hood is well known among all station men in the New England states, and owing to his extenive acquaintance, his business abilities, and the character of the goods he will handle, we have reason to believe that he will be successful in his new enterprise.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, Chicago,
November 17, 1894.

F. W. DAVIS, Secretary of the Perkins Electric Switch Manufacturing Company, of Hartford, Conn., was a recent visistor to Chicago.

THE HARRISON INTERNATIONAL TELEPHONE COMPANY report sixty-one exchanges under construction, and eighty-five already in operation. In the telephone business at least affairs are brisk.

THE METROPOLITAN ELECTRIC COMPANY is a busy firm just now. Anticipating a large fall trade (which came all right), it has a sufficient stock of specialties to fill all orders. It has made arrangements to handle the Allen Soldering Sticks and has a large stock on hand.

THE HORNBERGER ELECTRIC MANUFACTURING COMPANY, of Elkhart, Ind., have issued a very handsome little pamphlet descriptive of the Elkhart transformer. This is well filled with flattering testimonials, and the new president of the company, Mr. James F. Boss, who was a Chicago visitor during the week, reports business flourishing.

News of the Week.

TELEGRAPH AND TELEPHONE.

SHEBOYGAN, MICH., has passed an ordinance giving F. S. Dewey, of Alpena, a franchise to erect a telephone exchange.

LYNCHBURG, VA.—A new telephone company has been organized. The president is W. P. Roberts; vice-president, Edgar Franklin; secretary and treasurer, Walker Pettyjohn; directors, James Hancock, C. W. Scott, R. J. Snead, W. L. Pierce, H. P. Woods. They expect to have a line in operation by January 1st.

BOSTON, MASS.—The American Bell Telephone Company has voted to accept the act passed by the General Court of Massachusetts authorizing it to increase its capital stock. It was decided that the amount of the capital stock of the company be increased from $20,000,000 to $25,000,000, and the number of shares from 200,000 to 250,000, each of a par value of $100.

WASHINGTON, D. C.—An interesting situation in regard to telephones for the government is developing in the departments in this city. The question to be decided is one directly affecting the general use of instruments for governmental purposes. The varous departments require interconnection and also some economical means of internal communication. It is claimed that the rates of the telephone company, the licensee of the Bell Company, operated in Washington, and the well-known fact that it will only rent and not sell apparatus, have so far prevented the adoption of a system in all the departments that would largely dispense with messengers and act as a decided lubricant to the ponderous wheels of routine. The Interior Department has taken the initiative, and it will soon be settled whether or not a reliable telephone system can be owned and operated outside of the Bell privilege. Bids were received and opened a month ago, but were all rejected on account of technicalities. Hon. William H. Sims, Acting Secretary of the Interior, on November 15 extended invitations to manufacturers of telephones to enter bids for the construction of a system connecting the Interior Department and all its bureaus before next spring. If this is successful, it is probable that the Government will adopt the telephone largely as a valuable aid to business in all its branches. The proposals above referred to are to be opened at the Department of the Interior at 3 o'clock on Tuesday, December 18, 1894. Specifications will be furnished on application.

ELECTRIC LIGHT AND POWER.

PALMYRA, N. Y.—The village of Palmyra is agitating the electric light question.

ONEONTA, N. Y.—There is talk of changing the street car system in Oneonta to an electric road.

NEW ORLEANS, LA.—The New Orleans Traction Company will build an electric power plant to cost about $500,000.

FREDERICKTOWN, MO.—The proposition to light the streets of Fredericktown with electricity was carried at a special election.

LISBON, IOWA.—The firm of Adams, Green & Company, of Morrison, has obtained the contract to put in an electric light plant.

BOSTON, MASS.—The Holmes Electric Protective Company's plant was recently damaged by fire, and the estimated loss is $5,000.

WAPAKONETA, O.—Electric lighting proposition was defeatded at the election. Private parties will put in an incandescent lighting plant.

SEA ISLE CITY, N. Y.—Sea Isle City Electric Light Company has decided to substitute arc lights for the incandescent lights now in use on the streets.

WILKINSBURG, PA.—The Wilkinsburg Council has appointed a committee to investigate the feasibility of the city securing its own electric light plant.

THE CONEY ISLAND AND BROOKLYN RAILWAY COMPANY has petitioned for permission to extend its tracks through High street, from Jay to Washington street.

NORTH BRANCH, MICH.—North Branch will probably have electric lights soon, Rochester parties having offered to put in a plant in the village for a bonus of $400.

MANCHESTER, N. H.—The John B. Varic Company has asked permission to erect a power-house on the Bridge street extension. The request was granted on motion of Alderman Maxwell.

LE ROY, N. Y.—The Le Roy Hydraulic Electric Company was granted permission to string wires and erect poles for transmitting electricity for light on streets where there are no poles.

EAST ORANGE, N. J.—The people of East Orange are now discussing the matter of an electric light plant. It is estimated that for a sum of $50,000 a plant can be put in running order.

FLEMINGTON, N. J.—A meeting was held to obtain the opinon of the citizens regarding the lighting of the streets by electricity. The question was put to a vote and unanimously adopted.

SPRINGFIELD, ILL.—The Capitol City Electric Light Company, recently organized, is considering proposals for location of its plant, and also for machinery for the same. The plant will cost $100,000.

PORTLAND, ME.—A fire in the electric light works caused damage of less than $1,000 to the building, but all the valuable machinery was deluged with water, so that the loss will be $50,000, and perhaps more.

BUFFALO, N. Y.—Before the new year the American Structural Steel Company, of Pittsburg, will begin the building of a Bessemer steel plant, to cost $900,000. The company, it is said, will use electric power.

SAGINAW, MICH.—The Board of Water Commissioners on November 14 instructed the secretary to ascertain the cost of plants and feasibility of lighting two pumping stations with electricity. F. D. Keeler is secretary.

CLEVELAND, O.—County Auditor Schellentrager favors the erection of a complete electric lighting plant in the court-house, and the removal of the gas fixtures. There is plenty of power in the present engine-room to run the dynamos.

WEEDSPORT, N. Y.—Application has been made to the Board of Trustees of the village for an electric light franchise. The applicant is The Weedsport Spring Wire Truss Company. It is understood that the franchise has been granted.

HAMITLON, O.—At the meeting of the City Council, the contract for the Hamilton electric light plant was awarded to the Western Electric Light Company, of Chicago, at its bid of $30,680. It was for electric dynamos and line constuction only.

HADDONFIELD, PA.—At a meeting of the Borough Commissioners an ordinaance was passed giving the Haddonfield Light & Power Company the exclusive right to erect poles and string wires on the streets of the borough for a period of five years.

ROCHESTER, N. Y.—At a meeting of the Board of Trustees of the village of Waterloo, Trustee William L. Sweet reported that the officers of the Geneva & Waterloo Electric Railway had communicated with him, asking for a conference in regard to obtaining permission to build the road down through Main street.

NEW HAVEN, CONN.—The New England Public Works Company has been organized at New Haven with a capital of $25,000, to take contracts and to operate water works, electric light plants, etc. The subscribers are Edward H. Phipps and Wm. S. Pardee, New Haven; Chas. H. Eglee, Flushing, N. Y., and others.

MILLVILLE, PA.—A meeting of Common Council was held, to consider the new contract with the Millvile Electric Company for lighting the city. The contract expired November 1st. After somewhat lengthy discussion it was decided not to accept the figures, and the Light Committee was instructed to advertise for proposals.

CAMBRIDGE (BOSTON), MASS.—The joint special committee on municipal lighting of the Cambridge City Council held a meeting to consider the opinions requested of the city solicitor relative to the establishment of municipal lighting plants. The committee voted to accept the city solicitor's recommendations and report accordingly to the City Council.

BOSTON, MASS.—The Boston Electric Light Company has presented a petition to the Gas and Electric Light Commission, asking for an issue of $900,000 additional bonds. The company claims that the law compelling it to put its wires under ground has put it to a great expense, and this is one of the reasons assigned for the issue petitioned for.

THE ELECTRIC RAILWAY.

MIDDLETOWN, CONN.—Mayor Vinal has granted permission to the contractors to work the men on the electric road.

PELHAM MANOR, N. Y.—Pelham Manor residents are anxious for the extension of the trolley road to their village.

LANGHORNE, PA.—Work on the Hulmeville, Langhorne and Bristol trolley road will begin early next month at Langhorne.

READING, PA.—The Board of Trade recommends that the Council borrow $400,000 to put in a municipal gas and electric light plant.

CLARKSBURG, W. VA.—The Clarksburg & Suburban Street Railway Company has been incorporated to construct a street railway.

CAMDEN, PA.—The Camden Horse Railroad Company is placing trolley lines on Delaware avenue between Federal and Market streets.

BROWNSVILLE, N. Y.—The Street Railway Company is engaged in selecting a route for the proposed continuation of its line to Dexter.

HAMILTON, N. Y.—The Hamilton Electric Radial Railroad Company has prepared plans for roads spreading out from Hamilton in all directions.

BALTIMORE, MD.—If present plans are carried out Baltimore will be connected with Washington and Gettysburg by electric railways.

OSWEGO, N. Y.—C. B. Price purchased the Oswego Street Railroad, and said that a franchise will be asked for the extension of its tracks.

PROVIDENCE, R. I.—The Manville Mills, at Manville, will be lighted by electricity. The main office of the Manville Company is at Providence.

OTTAWA, CANADA.—One hundred thousand dollars are to be asked from this city as a bonus for the proposed Ottawa & Brockville Electric Railway.

IRONTON, O.—F. E. Holliday is at the head of the proposed Pomeroy & Middleport (O.) Street Railway, and in the market for second hand material.

CAMDEN, N. J.—The West Jersey Traction Company has asked permission to construct, maintain and operate a street railroad through certain streets of the city.

PORTLAND, ORE.—The plant that furnished the electric light at the Williamette Steam Mill, Lumbering & Manufacturing Company was destroyed by fire.

HARLEYSVILLE, PA.—Philadelphia capitalists have made applicaton for a charter for a trolley line from Spring House to East Greenville. The line is assured.

ST. LOUIS, MO.—The Citizens' Railway Company, Robert McCulloch, general manager, will soon be equipped with electricity. Ten miles of the road are operated by cable.

MANCHESTER, N. H.—A resolution has been introduced into the City Government allowing the Manchester Street Railway to erect wooden posts on Elm street for an electric road.

COLLINSVILLE, CANADA.—There is much opppositon here to the extension of the electric road from Unionville to this place. The selectmen do not favor the use of the highways for the purpose.

ANAHEIM, CAL.—Sealed bids will be received by M. Nebelung, clerk of the City of Anaheim, November 27th, for the construction of an electric light plant, as per plans and secifications on file in his office.

NORWICH, CONN.—The owners of property and those residing near the foot of Whittaker Hill have presented a petition to the Street Railway Company asking it to extend the tracks to the foot of Whittaker Hill.

PEEKSKILL, N. Y.—The Board of Trustees of the village will meet to give an opportunity for the citizens to be heard regarding the granting of a franchise to one of the trolley electric railway companies applying for it.

COLUMBUS, GA.—The Drake & Stratton Company, which has the contract for reconstructing the Columbus Railroad for its equipment with electricity, have commenced work. J. F. Flournay is president of the road.

NEW BRIGHTON, S. I., N. Y.—The Midland Railway officials presented a petition to the New Brighton Trustees asking for permission to change their motive power to electricity. The petition was referred to a committee.

SOUTH ORANGE, N. J.—The Newark and South Orange Railway Company has asked for consent and location of tracks or route in the township of South Orange. Elias S. Ward is president and Jos. H. Osborn, Township Clerk.

TOWER CITY, PA.—A movement has been commenced for the construction of an electric railway through the Williams Valley, commencing here and extending through Williamstown and Lykins. Right-of-way has been granted.

SOUTH ORANGE, N. J.—The South Orange & Maplewood Railway Company has asked for consent and location of the tracks or routes in the Township of South Orange. Frank Brewer is president and Jos. H. Osburn, Township Clerk.

WAVERLY, N. Y.—A project is on foot to connect Waverly and Elmira by an electric line, the tracks to follow the river road from the latter place and join the Elmira and Horseheads line with the Waverly, Sayre and Athens road.

READING, PA.—The Lititz Record says several gentlemen from Reading were in Lititz last week consulting with people about the building of an electric railroad from Manheim to Reading, the line to pass through Rothsville, Akron and Ephrata.

ST. LOUIS, MO.—Application will be made to the City Council for a franchise for an electric railway by the St. Louis & Southwestern Street Railway Company. George C. Fox is president of the company, A. E. Weiss, vice-president, and J. M. Wiener, treasurer.

WINTON PLACE, O.—Sealed proposals will be received until the 20th of Novemebr, 1894, for the construction and operation of street railroad route No. 1. Bids must be sealed and addressed to the Village Council of the Village of Winton Place, in care of R. B. Poage, Village Clerk.

BALTIMORE, MD.—Stockholders in the Clifton Passenger Railway Company have decided to take active steps towards the construction of the road, and to organize in December. The capital is $50,000, and the road is to be an electric one from Clifton Park to some point on North avenue.

COLUMBIA, PA.—Col. G. W. Bratton, of Philadelphia, and C. E. Hennessy, of Columbia, appeared before the council with an ordinance asking for the right of way through the borough for the line of the Columbia, Ironville and Mount Joy Traction Company. The matter will be considered.

RICHMOND, VA.—The special committe appointed by council met. The City Engineer and City Attorney will be requested to submit at the next meeting a statement as to the provisions of the charter in question and the relation of the Richmond Railway & Electric Light Company to the city.

BALTIMORE, MD.—The United States Circuit Court has decided that the Lake Roland Elevated Railway Company has the right to lay a double track on Lexington street, between North and Charles street. President James L. McLane, of Lake Roland Company, can probably give information.

FAIRHAVEN, MASS.—The hearing given by the Fairhaven selectmen to E. S. Brown and Lot B. Bates, a committe on the part of the Union Street Railway

Company, in relation to arranging terms for equipping the road in Fairhaven with electricity, was held in the town hall, Fairhaven. Nothing definite was arrived at.

SCHUYLKILL HAVEN, PA.—The Town Council of the borough of Schuylkill Haven adopted an ordinance giving the Pottsville & Reading Electric Railway Company a right-of-way over the streets of that corporation. Charles Barrett, president of the Schuylkill Electric Railway Company, and William Wilhelm, attorney for the former company, were the only representatives present.

PHILIPSBURG, PA.—Sealed proposals will be received by the Clearfield Traction Company, of Philipsburg, until December 4, for furnishing all material and erecting a boiler house, engine house, car barn, and office building at Philipsburg, Center County, Pa. Specifications may be obtained and plans examined upon application to either John G. Platt, or to E. W. Hess, engineer, Philipsburg, Center County, Pa.

BALTIMORE, MD.—The Washington & Baltimore Electric Railroad will, it is said, be built this fall, and work will be immediately commenced. The entire road from Washington to Baltimore has been surveyed and the section between Laurel and Washington will be built first. Two power-houses for the generation of electricity will be located, one at Laurel and the other somewhere near Washington. David M. Newbold is president.

SAN FRANCISCO, CAL.—E. P. Vining, formerly traffic manager of the Union Pacific Railroad, and arbitrator of the Western Passenger Association, is to take full charge of the street car lines in this city, owned and controlled by the Southern Pacific Company. Mr. Vining, who will receive $15,000 a year, will displace M. D. Stein, who has been general manager of the company since the consolidation of the various lines.

UNION, N. Y.—The projectors of the Binghamton, Lestershire and Union Railroad Company have applied to the trustees of the village of Union for the right of way through Main street in that village. The matter will be considered at a special meeting of the trustees to be held in Union, November 26th. Superintendent J. P. E. Clark of the Binghamton Street Railway Company, said that work on the road to Union will surely be commenced early in the spring.

HAMILTON, ONT.—Application will be made at the next session of the Ontario Legislature for the incorporation of the Toronto, Hamilton and Niagara Falls Electic Railway Company, with power to construct an electric line railway from the city of Hamilton to the Niagara River at or near Niagara Falls, and also a branch line from the village of Grimsby south through or near Dunnville. The application is being made by the same firm of solicitors as acted for the Lake Erie Acqueduct Company.

NEWTON, MASS.—A hearing has been granted to the Newton & Boston Street Railway Company on its petition for a location on the Commonwealth avenue boulevard, and on such streets as may meet the approval of the citizens of Newton Centre for a connecting line between the boulevard and the village. The Newtonville & Watertown Company will petition for a location on Watertown street, from Walnut street, Newtonville to the Wellesley line, and on Walnut street to connect with the tracks of the Newton & Boston road.

MISCELLANEOUS NOTES

A CORRECTION.—The suit against Mr. Westinghouse mentioned in our last issue, is brought by Mr. R. S. Waring, Jr., and not by the Standard Underground Cable Company as inadvertently stated in that item. Mr. Westinghouse is the president of the Standard Underground Cable Company. Mr. Waring was formerly connected with that company, but has not been so connected for about two years.

MR. HENRY H. WIEGAND will give a course of night lectures at Baltimore on the principals and practice of electricity, which will be adapted to the wants of those whose business brings them daily in contact with the practical applications of that science. The instruction will be in the form of lectures entirely, and free from abstruse mathematical calculations. The lectures will be illustrated by experiments, for which purpose ample apparatus has been provided.

THE WESTERN SOCIETY OF ENGINEERS on its November excursion visited the industrial works of South Chicago, including the following plants: Illinois Steel Company, Iroquois Furnace Company, Chicago Ship Building Company, and Morden Frog and Crossing Company. A special train, by the courtesy of the Baltimore & Ohio Railroad, was placed at the service of the society for the day. The policy of having such monthly object meetings seems to be a very wise one, and has also met with much success in the East, in the case of the New York Electrical Society.

THE ASSOCIATION OF PRACTICAL ELECTRICIANS OF CHICAGO, incorporated in April, 1894, and promises to have a successful career. The objects of the Association are the education and the advancement of the men engaged in electrical work, to a better knowledge of the science and practice of proper electrical installation and construction. Among the features is a corps of instructors elected at the annual meetings who shall give instruction in the respective branches for which they have been named, and a progressive series of examinations. The officers of the Association are: Geo. E. Sanford, president; G. H. Jacob, vice-president; J. L. Hagadorn, recording secretary, and G. H. Farrar, financial secretary.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold its 91st meeting at 12 West 31st street, New York City, on Wednesday, November 21st at 8 P. M. A paper will be presented by Prof. George D. Shepardson, University of Minnesota, Minneapolis, entitled "Suggestions for an Index of Engineering Literature." An opportunity will also be offered for the discussion of the paper read by title at Philadelphia, by Mr. Charles P. Steinmetz, of Schenectady, and Dr. Frederick Bedell, of Ithaca, on "Reactance, and Its Definition." A meeting of Western members will be held on the same evening at Armour Institute, 33rd street and Armour Avenue, Chicago. The secretary announces that the office of the Institute has been removed to rooms 1009 and 1010 Havemeyer Building, 26 Cortlandt street (10th floor), New York City, the change having been decided upon by Council after careful consideration during the past three months by a committee. The Institute meetings will be held at 12 West 31st street as heretofore, until further notice. The office will be open from 9 A. M. to 5 P. M., and is equipped with a long distance telephone, and district messenger service. Over 100 electrical, mechanical and engineering periodicals will be found on file. Members visiting this city will find the rooms as convenient for their accommodation as were those at the World's Fair.

Trade and Industrial Notes.

THE SLOSS-STEIN ELECTRIC COMPANY, Chicago, Ill., has certified to an increase of capital stock from $50,000 to $100,000.

THE LOUIS K. COMSTOCK COMPANY, electrical engineers and contractors Monadnock Block, Chicago, have recently opened an office in Detroit, Mich., in the Hodges Building.

THE INTERNATIONAL ELECTRICAL SUPPLY COMPANY, Detroit, Mich., is introducing a lock nut particularly adapted for street railway use. It consists of a right and left threaded bolt and nut keyed together and is specially adapted for use where there is much vibration.

THE ROYAL ELECTRIC COMPANY, Peoria, Ill., reports having made some heavy shipments of transformers during the past week. This company is meeting with much success with its transformers, whose claims have been upheld by the results of actual use during a period long enough to judge.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is making a special effort at present with C. E. M. jack-knife and motor switches. The C. E. M. Switch is one of the first jack-knife switches on the market having the spring catch to hold the jaw open or closed and give it a quick and positive action.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has contracted for the general western agency of the well known line of switches manufactured by the W. S. Hill Company, and has also the control in the West of the Kinsman desk lamp. The Central Electric Company will carry a complete line of these goods in its Chicago warerooms.

THE FOSTER ENGINEERING COMPANY, of Newark, N. J., has entered an order from Messrs. Cramp & Sons, for the equipment of the American liner "St. Louis" with the Foster pressure regulators. The order for immediate requirements includes six 8-inch—which is the largest valve the Foster Company has ever made for steamship service—eight 5-inch, and others of smaller sizes.

THE CLAYTON AIR COMPRESSOR WORKS, Havemeyer Building, 26 Cortlandt street, New York, have sent us a copy of their newest publication on the "Uses of Compressed Air." This list cites about seventy different applications of the air under pressure, and is a most convincing commentary upon modern advancement in engineering manufacturing and industrial lines.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has completed the new machine shop for the American Hard Fibre Company, at Newark, Del. It is 50 feet wide by 226 feet long, the roof being made of steel, and covered with anti-condensation corrugated iron roof covering. The same company has also just completed an addition, made entirely of iron and steel, to the works of the New England Electrolytic Copper Company at Central Falls, R. I.

THE GEO. F. BLAKE MANUFACTURING COMPANY reports that the Blake pump has been adopted by the Newport News Ship Building and Dry Dock Company for the U. S. gunboats numbers 7, 8 and 9, the contract having been awarded last week to the Geo. F. Blake Manufacturing Company. The contract includes Blake's special design of vertical duplex boiler feed pumps, fire pumps and bilge pumps; also an outfit of pumps for the distillers and evaporators.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., in a recent circular gives some information in regard to the care of leather belts. It recommends the use of a belt dressing instead of tighteuing the belts wherever possible, and condemns the use of soap, resin, tar and tallow—castor oil also being criticized. Two cases are cited where the most excellent results were derived from the use of Dixon's belt dressing and leather preservative, which was the only article that would start the big driving belt used at the Paris Exposition in 1878 and keep it from slipping.

I. P. FRINK, 551 Pearl street, New York, in a new and handsomely bound and illustrated catalogue of 96 pages, describes different forms of Frink reflectors, which have achieved a national reputation. Among these are a large number of different designs for church lighting, and we note an illustration of the corrugated glass lined parabolic arc light reflector used with so much success at the Wild West Show. There is also illustrated a line of electric and combination fixtures, and a large collection of commendatory letters bear evidence to the claims made for the Frink systems of interior lighting.

THE LOUISVILLE ELECTRICAL WORKS, of Louisville, Ky., are soon to place on the market a transformer which they promise will surpass any other transformer made. Its particular virtues lie in its high efficiency, high insulation qualities and simplicity. It is the invention of Mr. Frank Culver, formerly assistant electrician of the National Electric Co., Eau Claire, Wis., who has recently associated himself with the Louisville Electrical Works in the capacity of superintendent and electrician. The patents on this transformer, which have just been issued, are, we are informed, quite broad, especially upon the construction of the transformer core and fuse devices.

H. C. JOHNSON & COMPANY, 114 Fourth avenue, Pittsburg, Pa., have secured the electrical construction of the Homestead Street Railway from the end of the Pittsburg & Birmingham line to and through Homestead, Pa., a distance of 5 miles, the Homestead & Highlands Street Railway, an extension of the Schenly Park and Highlands Street Railway from the old road to and through Homestead and Munhall, Pa., a distance of 5½ miles. Work has commenced and is being pushed through on the first named which will be completed in two weeks and cars run by December 10th. The last named will be commenced next week and it will be finished in 10 days.

J. GRANT HIGH & CO., Philadelphia, manufacturers of switches and switchboards, report having done three times more business last month than any month during their experience in business. Among some of the recent orders received for switchboards are the following: One board 10 by 15 feet, from the Baltimore & Townsington Electric Railway, Baltimore, Md; one marble board, 5 by 10 feet, for the William Mann building, Philadelphia; one board, 6 by 10 feet, from the Harrison estate, Glenside, Pa.; also large orders for switches from Cuba and one from Paris, France. The firm has opened an office at 80 Medinah Temple, Chicago, with Mr. W. N. Famous in charge, where a full line of its goods will be carried.

THE CRESCENT ELECTRIC MACHINE COMPANY, 647 Kent avenue, Brooklyn, manufacturer of the Churchward-Perry system of electrical apparatus, is congratulating itself upon the success met with in business since its reorganization last January. The incorporated capital was $20,000, all paid in, and has been increased to $70,000, of which $30,000 is paid in. This company has orders on its books now for $15,000 worth of apparatus. Mr. M. T. Davidson, the well known steam pump manufacturer, is the president of the company. Other officers are: Jas. F. Scholes, vice-president; Wm. D. Perry, general manager; Wm. A. Drewett, superintendent; Geo. F. Simpson, treasurer; Jas. S. Simpson, secretary and Alex. Churchward, electrician.

THE BALANCED LOCOMOTIVE AND ENGINEERING COMPANY, capital $1,000,000, was incorporated with the Secretary of State November 14. The objects of the company are to manufacture and sell boilers, steam engines, locomotives, etc., and to contract for and erect power plants. The stock is divided into 10,000 shares of $100 each, and the company's principal office will be in New York City. The directors are: Henry Warden, owning 900 shares of the stock, George D. McCreary, 100 shares, both of Philadelphia; George S. Strong, who takes 100 shares by subscription, and 4,500 additional to be paid for by property, and Joseph Bushnell, 10 shares, both of New York City; George S. Morison, 100 shares, of Chicago; James McNaughton, 100 shares, of Albany, and Robert G. Bushnell, 100 shares, of Morristown, N. J. Henry F. Taintor, of New York, and Henry G. Morris, of Philadelphia, as trustees for the bondholders of the Strong Locomotive Company, take 1,500 shares, which is to be paid for by property.

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

TO WHOM IT MAY CONCERN.—Take notice that the co-partnership existing under the firm name of Bradley & Combs, doing business at Rochester, N. Y., has been mutually dissolved.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 13, 1894. *

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

528,924. RADIATING AND SUPPLY SYSTEM FOR THERMO-ELECTRIC GENERATORS; H. B. Cox, Hartford, Conn. Application filed February 27, 1894. A thermo-electric generator having a heat-controlled pulsating controlling means for the liquid supply for the liquid cooling chamber of the generator.

528,925. ELECTRICAL TRANSFORMER; F. S. Culver, Eau Claire, Wis. Application filed December 19, 1893. This comprises a casing, an insulated coil, a core formed of sections of L-shaped plates clamped and inclosing the coil, non-conducting strips and binding bolts by which the coil and its core are secured in the casing.

528,959. INTERSECTING ELECTRIC RAILWAY TRACKS; M. Lowd, Salem, Mass. Application filed February 10, 1894. This comprises an intersecting rail having a tread of insulating material and a base of metal, the intersecting rail being in the path of the current collector on the car.

528,960. SELF-WINDING ELECTRIC CLOCK; A. Lungen, New York, N. Y. Application filed May 13, 1893. The combination of an electro-magnet, an electric circuit, a vibrating armature, a notched wheel engaged and moved by the armature, a circuit closing lever also engaging with the notched wheel, the armature engaging the circuit closing lever and lifting it out of engagement with the wheel before it engages and moves the wheel itself.

528,963. UNDERGROUND CONDUIT FOR ELECTRIC ROADS; E. A. Mathers, Romeoville, Ill. Application filed June 12, 1894. The combination with the conduit, of a trench below the same, supports mounted in the trench, rollers journaled in the supports, a belt carried upon the rollers, and mechanism for moving the belts.

528,972. ORE WASHER OR CONCENTRATOR; C. F. Pike, Philadelphia, Pa. Application filed April 6, 1894. The combination of a receiving vessel, a suction discharge therein, and a magnet at or near the inlet of the suction discharge.

529,058. TROLLEY WIRE HANGER; J. M. Andersen, Boston, Mass. Application filed July 19, 1894. The combination with an insulator to which the trolley is secured, a socket for the reception of the insulator and in which the insulator is capable of rotary and longitudinal movement, and means to lock the insulator in adjusted position against rotary movement.

529,059. ELECTRICAL APPARATUS FOR CONTROLLING SIGNALS; S. S. Bogart, Schraalenburg, N. J., and M. B. Leonard, Richmond, Va. Application filed December 11, 1893. The combination with the main line and its keys, of the visual signals, their locking armatures and local circuit devices, and a switch at each station comprising a depending rod provided with a retracting spring and cross arms constituting contact points.

529,080. ORE WASHER OR CONCENTRATOR; C. F. Pike, Philadelphia, Pa. Application filed April 6, 1894. The combination of a receiving vessel, containing a body of water, a jigger bottom therein, transverse riffles on the bottom, a feed and a discharge inlet for the vessel, magnets located adjacent to the bottom of the vessel, and circuit connections including a source of electric supply for the magnets.

529,085. ELECTROMAGNETIC MACHINE; G. J. Scott, Philadelphia, Pa. Application filed June 12, 1894. An alternating motor having an armature provided with a closed ring conductor and field magnets, to induce in the ring opposed currents in the direction of its circumferential length, and collectors bearing upon the ring at different points, displaced from the neutral plane to produce a distorted field and connected up in closed circuit.

529,117. REGULATOR FOR DYNAMO ELECTRIC MACHINES; J. Ferrand, Darnetal, France. Application filed July 3, 1891. The combination with a shunt dynamo, of a regulator having one or more carbon columns through which the exciting current passes.

529,127. BINDING POST FOR ELECTRIC INSTRUMENTS; E. A. Lowe, New York, N. Y. Application filed February, 1894. This comprises a spring wire helix surrounding and larger than the stem of the post and adapted to receive a connecting wire passed through between its convolutions and around the post.

529,144. AUTOMATIC SET BACK ANNUNCIATOR; H. C. Thomson and G. J. Galbraith, Boston, Mass. Application filed July 2, 1894. This comprises a pointer magnet, standard, sliding core, weighted lever, spindle, sleeve, index finger, lift, an electromagnet with its armature pivoted upon ears, and an armature lever arranged to operate the lifting rod.

529,145. DYNAMO ELECTRIC MACHINE.; R. Thury, Geneva, Switzerland. Application filed August 18, 1894. This comprises two horizontal and superposed rings, each provided with a coil and a circular pole piece, in combination with an axis bearing a bell, the inner wall of which is provided with ranges of teeth.

* Owing to the patent specifications being received two days late, it was impossible to have the usual illustrations made for this issue.

529,152. ELECTRICAL TRANSFORMER; F. Zickermann, Berlin, Germany. Application filed December 9, 1892. This comprises a core, a sectional primary element, a sectional secondary element, and means for simultaneously increasing or decreasing the number of sections of each element in series.

529,165. TRAIN OPERATED SIGNALING MECHANISM; J. H. Frischen, Berlin, Germany. Application filed November 28, 1893. This comprises a series of track contacts, circuits controlled thereby, a switching device adapted to successively close the circuits synchronously with the actuations of the track contacts, signal devices, circuits thereto, and means for controlling the closing of the circuits successively synchronously with the actuations of the track contacts.

529,174. MAGNETIC TELEPHONE; O. Higgins, Napoleon, Ohio. Application filed July 16, 1894. A magnet having spools upon each end of the same, a case covering the magnet, diaphragms at each end of the same, and caps secured at each end of the case, holding the diaphragm in place.

529,199. METHOD OF AND APPARATUS FOR CIRCULATING LIQUID ELECTROLYTES; P. Schoop, Zurich, Switzerland. Application filed December 29, 1893. The combinations with a vessel, electrodes and connections, of a passage formed on the inner side of the vessel, and establishing a communication between the upper and lower parts of the vessel.

529,203. TELEPHONE; J. Serdinko, San Antonio, Texas. Application filed April 28, 1894. The combination with the magneto call instruments, and the bobbin and diaphragm, of a soft iron induction piece fixed between the magnets and diaphragm, a portion of the piece projecting into proximity to the diaphragm.

529,213. ELECTRICAL CUT-OUT; D. F. Sweet, Grand Rapids, Mich. Application filed June 9, 1894. The combination of an electromagnet, an armature carrying an arm and pivotally supported, a roller journaled in the arm, a spring pressed arm carrying a knife edge bearing on the periphery of the roller, a cam for adjusting the armature, an indicating finger, a swinging frame carrying contact plates, a latch engaging the frame, and means for disengaging the latch by the action of the armature.

529,216. CONDUIT FOR ELECTRIC CONDUCTORS; J. Tatham, Philadelphia, Pa. Application filed March 17, 1894. This consists of inner and outer tubes of lead, and an interposed tube of insulating material rigidly confined between the inner and outer tubes.

529,240. ELECTRIC ARC LAMP; J. Brockie, London, England. Application filed June 18, 1894. The combination of the carbon holders, of a rocking lever and an undulating groove.

529,263. APPARATUS FOR EXTRACTING GOLD; J. B. Hannay, Loch Long, Scotland. Application filed November 15, 1893. This comprises a vessel with an insulating lining, a carbon zone embedded in the lining and connected with a positive terminal, a mercury cup in the bottom of the vessel connected with a negative terminal, a rotary agitator in the bottom of vessel, and valved outlet pipes arranged at different levels.

529,265. MEANS AND APPARATUS FOR DISTRIBUTING ELECTRICITY; H. T. Harrison, London, England. Application filed January 19, 1894. The combination with the primary and secondary mains and transformers, of circuit connections whereby the transformers can be thrown in and out of action, and electromagnetic contact devices for controlling the connections.

529,272. ALTERNATING CURRENT ELECTRO DYNAMIC MACHINE; M. Hutin and M. Leblanc, Paris, France. Application filed August 20, 1893. This consists in generating independent currents by and in accordance with the variations from synchronism, and thereby producing upon the rotating element a couple of forces opposed to the variations.

529,297. STOPPING APPARATUS FOR ENGINES; N. E. Nash, Westerly, R. I. Application filed April 25, 1894. This comprises a rotary valve in the steam pipe, a weight attached to the operating arm thereof, and a box to receive the weight, the arm being connected to a normally open circuit whereby it will be sustained by the weight until the circuit is closed.

529,300. AUTOGRAPHIC TELEGRAPH; J. O'Neil, New York, N. Y. Application filed November 27, 1893. This comprises a feed roll, means for moving same, a screw revoluble in opposite directions and placed parallel to the feed roll, a traveling nut upon the screw a stylus carried by the nut, and a motor to communicate motion to the screw.

529,313. ELECTRIC GAS LIGHTER; C. G. Savage, Philadelphia, Pa. Application filed June 13, 1894. This comprises an operating lever, an arm pivoted thereto but insulated therefrom, the arm adapted to come in contact with the lever on its forward stroke.

529,325. ELECTROMAGNET; C. C. Gerlach, Cleveland, O. Application filed December 9, 1893. A coil the surface of which is partially wound with flexible non-conducting material, in such a manner as to present alternately the covered and bare wire, and to admit an insulating medium between the strands.